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PROTOZOA.

PART II.—FORAMINIFERA.

BY

EDWARD HERON-ALLEN, F.R.S.,

AND

ARTHUR EARLAND, F.R.M.S.

WITH ONE FIGURE IN THE TEXT AND EIGHT PLATES.

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CONTENTS.

1. INTRODUCTION.

(i) MATERIAL.

SEVEN years have passed since we received from the present Director of the Natural History Museum fifty-four tubes and forty-three jars of varying sizes containing material for examination and report. The work has necessarily been retarded by the War, but has resulted in the recording of more than 650 species and varieties of Foraminifera, forty-six of which are new to Science.

Before the Expedition started we were consulted as to the best methods of collecting, and gladly gave the results of many years' experience, but circumstances appear to have rendered impossible any serious attempt at the collection of foraminiferous material. Apart from the tubes containing the "cores" of soundings (which are of little value from a faunistic point of view), and a few sands from the New Zealand coastal area, the material received consisted principally of sandy débris, evidently the residuum from gatherings of assorted Benthos, and usually "preserved" in formalin, than which no more unsatisfactory medium for the "preservation" of Foraminifera can be imagined.

Now such débris is of course foraminiferous, often rich, but as compared with specially collected material it is extremely difficult to clean, and the results are often fragmentary. Neither time nor trouble was spared in the tedious processes involved, but from the point of view of specialists we can only view the results as a tantalising sketch of the possibilities which would have attended upon an ample supply of properly collected Antarctic material.

The method of preparation employed was to wash the material on graded sieves ranging down to silk gauze of 160 meshes to the linear inch. The material thus retained is referred to in the subsequent report as "Sieves," while the finest mud, passing through the silk gauze, and subsequently separated by means of a filter-paper, is described as "Residues."

It may be noted here that we received no material whatever from five of the "Antarctic Benthos" Stations in the Official List, but we have received facilities for examining some of the Sponges collected at these Stations for sessile species. Also that three jars of material were entirely unlocated and some others bore no Station numbers. These were successfully placed by a comparison of the fauna contained.

Our researches have confronted us with several notable *lacunae*. Conspicuous by their absence, for example, are *Miliolina bicornis*, *Keramosphaera murrayi*, *Hyperammina friabilis*, *Candeina nitida*, *Anomalina ammonoides*, and *Pulvinulina menardii*, all of which have been recorded from similar localities by Chapman or by Pearcey.

A striking feature of our records is the occurrence of arenaceous isomorphs of various forms hitherto known only as porcellanous or hyaline. These have

afforded an opportunity of adumbrating in Section V. of this Introduction a more scientific classification of the Order, especially in regard to the family Lituolidae. The occurrence of such arenaceous isomorphs might have been reasonably anticipated in the Antarctic. The substitution of an adventitious test for one composed of calcium carbonate is no doubt a physiological process due to the low temperature of the animal's environment. It has long been observed that tropical organisms secrete calcium carbonate in great abundance, while benthic and Arctic organisms are characterised by thin, delicate shells, and the experiments of Murray and Irvine proved that the reactions involved in the fixation of $CaCO_3$ were retarded by cold and accelerated by heat. (But see p. 34.)

The fossil or sub-fossil material received from Stations 2, 3, and 6 presents some difficulty. The distinctive nature of the material does not appear to have been recognised when it was obtained from the dredge, and no records were made of its occurrence and relative abundance. The material from these Stations therefore consists of: (1) recent muds and sands easily recognisable as such; (2) more or less disintegrated lumps of the deposit in question; (3) a mixture of the two in which it is not always possible to discriminate between the constituents.

Some of the harder lumps of this deposit have been submitted to various authorities who, as a rule, decline to commit themselves to any definite statement as to its age. The general consensus of opinion is, that the deposit is probably of no great antiquity but represents a recent sea-bottom consolidated by the solution and subsequent re-deposition of $CaCO_3$ in sea water.

Mr. A. W. Waters, on the other hand, after preparation and examination of the material, is inclined to attribute a Tertiary origin to the deposit, on the strength of the occurrence therein of certain Polyzoa (*Cellaria angustiloba*, *Entalophora verticillata*, *Cellepora fossa*) known only as typical Tertiary fossils. He compares the Polyzoan fauna with certain beds in Victoria attributed to the Miocene or Oligocene.

The matter lies outside our province and can only be settled by a further examination of suitable material. We will only observe that if the deposit is of the age suggested, we should have anticipated the occurrence of similarly typical Tertiary Foraminifera. With the exception of a single specimen of *Nummulites variolarius* found at an early stage of our work, anterior to the receipt of Mr. Waters's report, no distinctive fossils occur among the Foraminifera.* The species listed from the hard deposit are to all intents and purposes identical with the recent forms at the same Stations, and any differences are principally due to development, which is usually more noticeable in the fossil than in the recent

* We had rejected this Nummulite without hesitation as due to extraneous circumstances, although we felt that all possible precautions had been adopted in cleaning the material, but in view of Mr. Waters's report its occurrence, if accepted, has obviously a considerable value as evidence in support of his theory.

specimens. One point only appears to us to be definitely proved by the comparatively low percentage of mineral grains, viz.: that the deposit was laid down at a time, and under conditions, when the shore-line was at a far greater distance from the Stations in question than it is to-day.

(ii) LITERATURE.

The multitudinous and world-wide material collected by d'Orbigny prior to 1826, the date of his "Tableau Méthodique," included none from Antarctic regions. Freycinet and Duperrey, from whom he received much material, did not cruise S. of Tasmania.

The literature of our subject may be said to commence with a paper presented by Ehrenberg to the Berlin Academy in 1844, dealing with material collected by Dr. J. Hooker on the cruise of the "Erebus" and "Terror," under Sir James Ross.* A volume of 100 pp. was issued containing instructions to observers and collectors upon this voyage, the data and material collected to be worked out at home after the return of the Expedition.† According to Ehrenberg it was he who caused Humboldt to press for the collection of micro-organisms and to prescribe the methods of collection. We are told that in January 1841, lying becalmed, Ross put over a dredge which brought up rock fragments and "a surprising profusion of animal life." Dr. J. Hooker collected forty packets of soundings from Cape Horn to Victoria Land, and three jars of water which were sent to Germany, and we read that forms collected in 1842 near Victoria Land were still almost fresh when they reached Germany in 1844. Hooker and Ehrenberg both worked on the material, and the conclusions arrived at by Ehrenberg were, shortly, that the relations of organic life were identical at the North and South Poles, that the surface layers ("Pancake ice") were crowded with life, and that the supposition that organisms cannot live below 100 fms. had become untenable.‡

At the time Ehrenberg wrote, only three packets, between 63° and 70° S. (190–270 fms.) had been examined; what became of the rest is not known to us. On p. 188 he records, as found by Hooker, in floating ("Pancake") ice, from 78° 10′ S., 162° W., four Foraminifera; of three of these he gives a nebulous diagnosis on pp. 207–8, the other is simply recorded as "*Spiroloculina*." The three diagnosed forms are: (1) *Grammostomum divergens*, which he subsequently

* C. G. Ehrenberg. "Vorläufige Nachricht über das kleinste Leben im Weltmeer, am Südpol, und in der Meeres Tiefen," Monatsber. Berliner Ak. Wiss., 1844, pp. 182–207.

† The reader is referred to Dr. H. R. Mill's work "The Siege of the South Pole" (London, 1905, pp. 252–326.) The "Erebus" and "Terror" started from England Sept. 30, 1839, and were within the Antarctic Circle (S. of 66° 30′ S. lat.) between Jan. 1 and March 4, 1841, Jan. 1 and March 6, 1842, and March 1 and March 11, 1843. They returned to England in September, 1843.

‡ An abbreviated translation of Ehrenberg's paper was published in Ann. Mag. Nat. Hist. xiv, 1844, pp. 169–181, "On Microscopic Life in the Ocean at the South Pole and at Considerable Depths."

figured (E. 1854, M. xxxv. A. Fig. xxii, 22)* and recorded as "*Guttulina? divergens* and *Grammostomum*, 1844." Sherborn suggests *Bulimina*, and it is probably referable to that genus, of the *B. pupoides* type. Ehrenberg also records the same species (on p. 192) from Gulf Erebus and Terror, 63° 40′ S., 55° W. (270 fms.).† (2) *Rotalia antarctica*, and (3) *R. erebi*. He gives no figures, but from the diagnosis they appear to be starved forms of *R. beccarii* (Linn.). And then came what Dr. Mill calls "the generation of averted interest." No other exploration of importance, and certainly no collection of material took place in Antarctic waters until the voyage of the "Challenger" in 1874, whose "furthest south" was 66° 40′ S., 78° 30′ E., S. of Kerguelen Island. But the "Challenger" made the first systematic series of soundings in the Antarctic, and the statement was made that here the Globigerina ooze (or Red Clay in deeper water) merges into Diatom ooze, and then into terrigenous Blue Mud. (*Cf.* Dr. Harvey Pirie's Map in P. 1913, S.N.A.)

The principal works dealing with the Foraminifera of our areas are, for the New Zealand area, Chapman 1905, G.B. I; 1909, S.N.Z.; and Cushman 1919, R.F.N.Z.; the latter paper being founded merely upon four type-slides, sent to the author by our late friend Mr. R. L. Mestayer, of Wellington, N.Z., containing specimens from the "Poor Knight's" Islands (35° 30′ S., 174° 43′ E.); it therefore lacks the authority of Chapman's papers, which were the outcome of research upon ample material. For the Antarctic area, the works available to the student are Pearcey's paper on the Foraminifera of the Scottish Antarctic Expedition, 1902–4 (P. 1914, S.N.A.), in which he records 242 species and varieties, and Dr. Harvey Pirie's paper on the Deep Sea Deposits (P. 1913, S.N.A.), which, however, records no species other than those listed in Pearcey's memoir. Our friend Mons. E. Fauré-Fremiet has contributed two papers on the French Antarctic Expedition of the "Pourquoi pas?" (F. 1913 and 1914, F.M.A.F.). M. Fauré-Fremiet is an excellent worker, but unfortunately his material must have been very inadequate, for he only records fourteen species. In 1914 Chapman, in the Reports of the Shackleton Expedition (1907–9), contributed two papers, one Geological (C. 1914, E.D.R.S.) on (*a*) a deposit 20 feet above sea-level N. of the Drygalski Glacier, and (*b*) another from the slopes of Mt. Erebus, 160 feet above sea-level; the other, Recent (C. 1914, F.O.R.S.), from soundings in the Ross Sea, in which he records sixty-six species and varieties.

It is obvious that the material submitted to these authors was very inadequate, but we made, originally, a point of giving references to their papers in the synonymies of all species and varieties recorded by us from the far more extensive material submitted to us for examination. The drastic reduction of synonymies

* For explanation of the method employed by us, with a view to economy of space, in all our bibliographical references, see p. 236.

† Ehrenberg's figure of *G. divergens*, Pl. xxi, fig. 86, is *Bolivina dilatata*, Rss., a quite different form.

explained on p. 58, necessitated by the present conditions of cost of printing and paper has compelled us to excise this portion of our work, but the papers themselves are no doubt readily accessible to the student.

It remains only to say that, though as we have indicated (*supra*), the gatherings consigned to us might have been much more exhaustive and representative than they are, the material analysed in this Report is by far the most voluminous that has been brought to this country from either New Zealand or the Antarctic regions.

(iii) ARCTIC AND ANTARCTIC TYPES OF FORAMINIFERA.

It is not easy to form any comparison between the foraminiferal fauna listed in our Report and the tables of species from high latitudes published by Brady (B. 1884, F.C., pp. 779–785), because, of the eight Antarctic stations figuring in his list, five are from localities on or adjacent to the Southern extremity of the American continent, and two of the other Stations represent rich insular gatherings round Kerguelen Id. and Heard Id. The remaining list is from "Challenger" Station 150 in the Southern Ocean (52° 4′ S.) in 150 fathoms. This is approximately the latitude of our Stations 11 and 12 (Official Stations Nos. 208–9), and the depth is very similar, but the nature of the Challenger material, which was organic débris from a rocky bottom, yielding only sixteen species of Foraminifera, forbids any direct comparison with the oozes obtained at these two "Terra Nova" Stations. Brady did not list the species derived from the deep water "Challenger" Stations off the Ice Barrier (Stn. 153—1,675 fms., Stn. 155—1,300 fms., Stn. 157—1,950 fms.), all of which would have afforded suitable material for a comparison with our Report.

Murray in the "Summary of Scientific Results of the Voyage of the 'Challenger'" (1895), vol. 1, p. 498, gives a list of forty species of Foraminifera from Station 153. This is probably not exhaustive. It contains many interesting forms, but perhaps the most noticeable point is the absence of *Globigerina pachyderma* (Ehbg.), and the presence of *G. dutertrei*, d'Orb.

Nor is it easy to make any direct comparison with the foraminiferal fauna from Arctic latitudes given in the same table because our list includes many deep-water Stations, whereas 300 fathoms represents the maximum depth in Brady's list. But a comparison of the species in Brady's Arctic and Antarctic lists with our own records yields some noticeable results, in some respects confirming Brady's observations and in others disproving them.

Thus Brady records the following species as Antarctic but absent from the Arctic: -

1. *Articulina funalis*, Brady.
2. ,, ,, var. *inornata*, Brady.

3. *Clavulina communis*, d'Orbigny.
4. *Sagrina raphanus*, Parker and Jones.
5. ,, *dimorpha*, Parker and Jones.

Nos. 1 and 3 are abundant in our Antarctic material, but the others do not occur.

Again Brady comments on the fact that the following forms occur in the Arctic, while no representatives of these genera occur in the Antarctic :—

1. *Verneuilina polystropha* (Reuss).
2. *Bigenerina nodosaria*, d'Orb.
3. *Spiroplecta biformis* (P. & J.).
4. *Polymorphina acuminata* (d'Orb.).
5. ,, *compressa*, d'Orb.
6. *Polymorphina lactea* (W. & J.).
7. ,, *oblonga*, d'Orb.
8. ,, *rotundata* (Born.).
9. *Operculina ammonoides* (Gron.).

But No. 1 appears in our Antarctic list with four other species of *Verneuilina* ; No. 3 with another species, *Spiroplecta annectens* (P. & J.) ; No. 9 occurs, and although only Nos. 5 and 8 are represented in our list of Polymorphinae, our Antarctic species of that genus number eight, as against Brady's five from the Arctic and none from the Antarctic. Possibly the most striking fact in the comparison of the Polymorphinae lies in the entire absence of *P. lactea* (W. & J.) from both Antarctic lists, though it figures at five out of six of the Arctic Stations. It looks therefore as though *P. lactea* may be regarded definitely as absent from the Antarctic. *Operculina ammonoides* (Gron.) occurs at several Antarctic Stations.

Among Brady's other deductions are :—

1. That *Uvigerina* and *Sagrina* replace *Polymorphina* in Southern latitudes. With this we cannot agree for reasons already given.

2. That *Clavulina* (*C. communis*, d'Orb., understood) similarly replaces *Bigenerina*, which appears to be correct.

3. That the porcellanous forms display a more varied development in the South than in the North. In support of this he lists twenty-four porcellanous species, nineteen of which are Antarctic against ten in the Arctic list. There are twenty-six porcellanous forms in our Antarctic list, including several species not common to our own list and Brady's, so the deduction appears to be correct if the Arctic list may be regarded as fairly complete.

4. That the Northern region is much richer in—

(*a*) The Textularian types :
(*b*) Polymorphinae ;
(*c*) Nonioninae.

As regards (*a*) the deduction is based on a list of twenty-seven Textulariidae, nineteen of which are recorded by Brady as Antarctic and only sixteen as

Arctic. The reasoning is therefore at fault if Brady had "species" in his mind. If however "number of specimens" was intended we may perhaps agree, as, with certain exceptions (*Clavulina communis*, *Cassidulina* (various species), *Bulimina chapmani*, *Ehrenbergina hystrix* var. *glabra*, etc.) the Textulariidae occur very sparingly in our Antarctic material. The genus *Textularia* itself is represented in our list by a single deep-water form, *Textularia concava* var. *heterostoma*, Forn., as against three species in Brady's Antarctic list and two in his Arctic list; and other genera, where represented at all, are usually very rare. But we have some forty-seven species and varieties of Textulariidae on our list, south of the Antarctic Circle, so Brady's conclusion must not be accepted without further evidence. As regards (*b*) we have already stated the reasons for our disagreement with Brady's conclusion.

As regards (*c*) Brady lists eight species of *Nonionina*, all of which figure in the Arctic fauna, but only four of them appear in his Antarctic list, and these are confined to the Patagonian localities and do not figure in the Kerguelen, Heard Island or Southern Ocean material. Our experience is very different, for we have eight species on our Antarctic list and one of them is *Nonionina stelligera*, d'Orb., which is one of the most characteristic Northern forms. It figures in all the Arctic Stations of Brady, but at only one Southern Station, off the Patagonian coast.

Hence we may regard this conclusion of Brady's to be unfounded also.

Brady's tables include fifty-three genera and 189 species, of which forty-four genera, represented by 137 species, occur in the Southern area and forty-one genera, represented by 111 species, occur in the Northern area; thirty-two genera, represented by sixty species, being common to both areas.

Such a large proportion of forms common to Northern and Southern waters might be used as evidence in favour of the theory of bipolarity by a zoologist unfamiliar with the group, but to the rhizopodist the presence or absence of a few particular species would be more convincing evidence than the longest list of other forms. This, for the reason that, apart from those genera and species limited in their distribution by conditions of mean temperature (which form the characteristic shallow water foraminiferal faunas of different latitudes), the mean temperature at all depths below 500 fathoms all over the world does not vary more than a few degrees, and so would constitute no barrier to the gradual migration of Foraminifera from one pole to the other by way of the cold waters of the deep sea. Hence we should be loth to accept the existence of any species or number of species in both Arctic and Antarctic waters as evidence in favour of bipolarity, but should be prepared to regard the absence from either region of a species *known to be peculiarly characteristic of the other region* as definite evidence opposed to the theory.

Brady's list of Arctic Foraminifera contains at least three species peculiar to

Arctic and adjacent seas. They are *Reophax arctica*, Brady, known only from the Arctic, and by a few pauperate specimens from Delos (Sidebottom), *Hippocrepina indivisa*, Parker, known from the Gulf of St. Lawrence, the Arctic seas, and in a starved form from the Moray Firth; *Polystomella arctica*, P. & J., perhaps the most typical and abundant of all Arctic species, a large, strong species which cannot be overlooked and with a Southern limit about the Moray Firth.

None of these three forms have ever been recorded from the Southern area, and but for the occurrence of a single specimen (broken) of *Hippocrepina indivisa* in our own records we should regard their complete absence as more striking than the occurrence of a multitude of other species which have a more or less universal distribution.

It is more difficult to select similar forms from the Southern area, but there are two characteristic Antarctic forms which may be considered, viz.:

(1) *Articulina funalis*, Brady, abundant in the farthest South gatherings. This has been recorded also from shallow water in the tropics, but never, so far as we know, in Northern Seas.

(2) *Ehrenbergina hystrix*, Brady, represented abundantly in the Antarctic by our variety *glabra*, and otherwise known only from deep water in the Pacific.

Practically the only species (so called) which could be invoked as evidence of bipolarity is *Globigerina pachyderma* (Ehbg.). This curiously thick-walled and very characteristic form is the typical *Globigerina* of Arctic deposits. *Pace* Sir John Murray* it is a purely benthic form, its very structure is opposed, in our opinion, to any idea of its existence in the pelagic state. Abundant in the Arctic oozes, it becomes rarer in the North Atlantic, and, save for perhaps an occasional doubtful specimen, such as the records from the Pacific (B. 1884, F.C., p. 777), reaches its southern limit in the Färoe Channel. It does not form a constituent of the bottom oozes of temperate and warm seas, as might be expected if it were either

(1) Pelagic, as stated by Murray, we believe in error.

(2) Benthic, but generally distributed.

Yet *Globigerina pachyderma* (Ehbg.), occurs in the Antarctic as the typical *Globigerina* at all depths.

As we have stated elsewhere in our notes on the two species, the explanation of the occurrence of this Arctic form in Antarctic oozes, and its absence in intermediate deposits, lies in the fact that it is not a true species, but a local variation of *Globigerina dutertrei*, d'Orb., induced by conditions of temperature. The same gradual transition of the one type into the other which we have described in the Antarctic could be traced in the Arctic and temperate seas, and although the records of *G. dutertrei* are singularly few (probably because it is

* J. Murray, "The Ocean" (London, n.d.) 1913, p. 165 and "Pelagic Foraminifera" 1897, Nat. Science, vol. xi, pp. 17–27.

indistinguishable in the superior aspect from *G. bulloides*), it is known to be a pelagic species and is doubtless of world-wide distribution.

The replacement of the comparatively thin-walled Globigerinae of warm seas by thicker-walled types, like *G. dutertrei* and *G. pachyderma*, as one approaches the poles, is a very remarkable fact and at variance with the general rule that organisms secrete calcium carbonate in greater abundance under tropical conditions than under arctic. It might be expected that their arenaceous isomorphs would increase in abundance. But the arenaceous isomorph of *Globigerina* (*Haplophragmium globigeriniforme*) is not more prevalent in the Arctic and Antarctic than elsewhere. *Vide* our previous reference to this subject on p. 27.

Incidentally, the records of *G. pachyderma* in Brady's list (B. 1884, F.C. p. 784) are puzzling in the extreme. He records it at four out of the six Arctic stations but at none of the Antarctic, and in his description of the form (B. 1884, F.C. p. 600) he does not refer to its occurrence at any point south of the Färoe Channel. Yet he, of all men, must have been thoroughly familiar with the type, for he rediscovered the species, which had been described in 1861 and figured in 1873 by Ehrenberg, and then forgotten. The only explanation possible seems to be that some of Brady's assistants who worked out the Antarctic material for him overlooked the extreme "*pachyderma*" type and selected the starved "*dutertrei*" specimens instead. *G. pachyderma* can hardly have been lacking at "Challenger" Station 150.

(iv) PELAGIC FORAMINIFERA.

Eighteen tubes of tow-nettings taken by the Terra Nova were placed in our hands for examination. They covered the whole period of the voyage, four being from Stations in the Atlantic on the outward cruise, five from the seas round the extreme north end of New Zealand, and the remaining nine being spread over the area between the South Island of New Zealand and the Antarctic coast-line. Eight of the stations yielded pelagic Foraminifera, but as three of these were from the warm Atlantic, and four from warm New Zealand seas, they present little interest for this report. The eighth and most southerly tow-netting in which pelagic Foraminifera were detected was from Station (Off.) 167.

Unfortunately, all the material had been preserved in formalin, than which as we have observed (*ante*), no more unsatisfactory medium for pelagic Foraminifera can be conceived. As a result all trace of the thin calcareous shells had vanished and nothing was left but the protoplasmic bodies of the animals held together by the delicate chitinous lining of the original shell. Identification of species has therefore been confined to those forms in which the shape and method of arrangement of the chambers is sufficiently distinctive for recognition. Probably pelagic forms had been present in most of the other gatherings, but had become too much destroyed for recognition. The incident is the more unfortunate as

information on the distribution of pelagic species in the Antarctic seas is much wanted and particularly in respect of *Globigerina pachyderma* (Ehbg.).

The question whether *Globigerina pachyderma* exists in the pelagic state remains still open to doubt. The species was first described by Ehrenberg from 1,000 fathoms in Davis Straits. It was recorded in the material from the Austrian Arctic Expedition of 1872–4, and the British Arctic Expedition 1875–6. The "Knight Errant" dredged it in the cold area of the Färoe Channel in 1880. All these records are of benthic specimens. Brady, in his report on the Foraminifera of the cruise of the "Knight Errant" (B. 1882, F.K.E., p. 717) states definitely that no specimens occur in any of the surface mountings, and remarks "that the small northern variety of *Globigerina*, which is tolerably abundant as a bottom species in three out of the five localities, should not be an equally prominent constituent of the surface fauna is a noteworthy fact."

In the "Challenger" Report (B. 1884, F.C., p. xiii) Brady went even farther. Commenting on the bottom distribution of *G. pachyderma* in the Färoe Channel, abundant in the "cold" area and more sparingly at one station in the "warm" area, he states that "in the tow-net gatherings *G. bulloides* was equally plentiful over the cold and warm areas; but neither there, nor hitherto in any other region, has *G. pachyderma* been met with at the surface." And in the light of his examination of the tow-net collections of the "Challenger," his subsequent remark under the description of the species (*op. cit.*, p. 600), "I have never succeeded in finding it in the tow-net gatherings, although small examples of the typical *G. bulloides* are not uncommon amongst the surface organisms of the same areas," crystallises his views on the subject.

Murray and Renard in their Report on the Deep-Sea Deposits of the "Challenger," 1891, p. 214, give a list of 21 pelagic Foraminifera. It differs in several respects from the list of 20 species given by Brady (B. 1884, F.C., p. x), two species, *Chilostomella ovoidea*, Reuss, and *Pulvinulina patagonica* (d'Orb.), which appear in Brady's list, disappearing and being replaced by three additional species of *Globigerina*, viz.: *G. digitata*, Brady, *G. cretacea*, d'Orb., and *G. dutertrei*, d'Orb. There is still no suggestion that *G. pachyderma* (Ehbg.), exists in the pelagic state.

In 1897 Murray published his paper on Pelagic Foraminifera in which he extends the list of species to 26. *Pulvinulina patagonica* reappears, and four additional species of *Globigerina*, including *G. pachyderma*. Murray also states that "in the Arctic and Antarctic regions *Globigerina dutertrei* and *G. pachyderma*, together with very minute specimens of *Globigerina bulloides*, appear to be the only forms present in the surface waters."

Just before his death, Murray published his little book on Oceanography, "The Ocean" (London, n.d., [1913]). On page 165, writing of pelagic Foraminifera, he states: "Towards the equator more than 20 species may be found

in the tow-nets, but they gradually disappear as we proceed into colder water towards the poles; only one species of *Globigerina* (*G. pachyderma*) is found living in the Arctic surface waters and another species (*G. dutertrei*) in the Antarctic waters. Some authors regard these two species as identical."

With the purport of Murray's last sentence we are in agreement (*Vide sub G. dutertrei* and *G. pachyderma* in our Report). But with the earlier statements we must disagree. No evidence is produced in support of the statement that *G. pachyderma* is pelagic, but Pearcey and ourselves have demonstrated the existence of both forms in the Antarctic oozes. The whole structure of *G. pachyderma* is so dissimilar from the other recognised pelagic species in its massive walls, minute oral aperture and absence of external spines that we must decline to accept Murray's conclusions until definite evidence of its occurrence in tow-nettings is produced. For this reason we regret that the few "Terra Nova" gatherings submitted to us afford insufficient evidence even for the rejection of Murray's record.

The "Terra Nova" tow-nettings examined yielded the following results:—

Station No. 5, June 21, 1910, 38° 37′ N., 14° 42′ W. Surface. Full speed tow-net, 12.30 to 1.15 p.m. Species identified: *Globigerina aequilateralis*, Brady, *G. bulloides*, d'Orb., *G. conglobata*, Brady, *Orbulina universa*, d'Orb.

Station No. 7, June 23, 1910. Flora Light, Madeira, N. 60°, E. 7 miles. Surface. Full speed tow-net, 3.15–3.45 p.m. Species identified: *Globigerina bulloides*, d'Orb., and *Orbulina universa*, d'Orb.

Station 34, July 14, 1910. 2° 38′ N., 21° 16′ W. Depth, 1 metre. Full speed tow-net, 2–3 p.m. Species identified: *Globigerina aequilateralis*, Brady, *G. bulloides*, d'Orb., *G. conglobata*, Brady, *G. sacculifera*, Brady, *Pulvinulina menardii* (d'Orb.), *P. canariensis* (d'Orb.).

Station 115, August 16, 1911. 34° 32′ S. 172° 20′ E. Surface. Full speed tow-net, 3–5 p.m. Species identified: *Globigerina aequilateralis*, Brady, *G. sacculifera*, Brady, *Pulvinulina crassa* (d'Orb.), and two minute specimens of *Haplophragmium canariense* (d'Orb.), recognisable with certainty owing to the agglutinate tests which had not been acted on by the formalin and had preserved their ferruginous tint. These are clearly benthic specimens derived either from wave action if the tow-net was over shallow water (no depth recorded for this Station, which was in the neighbourhood of land), or from the washing of dredged material just before the tow-net was used. Such accidental occurrences are, in our experience, frequent in tow-nettings.

Station 123, August 19, 1911. Between North Cape and Doubtless Bay, New Zealand. Surface. Full speed tow-net, 11 a.m.–4 p.m. Species identified: *Globigerina bulloides*, d'Orb., *G. dutertrei*, d'Orb., *Orbulina universa*, d'Orb. *Pulvinulina canariensis* (d'Orb.); also two small benthic specimens, *Pulvinulina*

or *Discorbina* sp. (?) (decalcified and unidentifiable) and *Textularia conica*, d'Orb., undecalcified and distinctive. Their presence is doubtless due to one of the reasons already given, probably wave-action.

Station 124, August 23, 1911. Between North Cape and Doubtless Bay, New Zealand. Surface. Full speed tow-net, 9 a.m.–1 p.m. Species identified: *Globigerina bulloides*, d'Orb., *Orbulina universa*, d'Orb., *Pulvinulina crassa* (d'Orb.), and one small benthic specimen of *Haplophragmium canariense* (d'Orb.).

Station 167, December 7, 1910, 61° 22′ S. 179° 56′ W. Surface. Full speed tow-net, 4 p.m.

This was the most southerly gathering submitted to us in which we detected pelagic Foraminifera. It was essentially a diatomaceous gathering, but the following species were identified: *Globigerina aequilateralis*, Brady, *G. bulloides*, d'Orb., *G. dutertrei*, d'Orb.

Station 206, December 16, 1911, 45° 25′ S., 172° 28′ E. Surface. Full speed tow-net, 9 a.m.–1 p.m. Species identified: *Globigerina bulloides*, d'Orb., *G. dutertrei*, d'Orb., *Hastigerina pelagica*, d'Orb.

Besides the above, gatherings were examined without result as regards pelagic Foraminifera from Stations 30, 102, 137, 180, 186, 207, 217, 267, 313, 344. In view of the preservative employed and the consequent decalcification of the tests, the absence of pelagic Foraminifera at these stations must not be regarded as conclusive.

In addition to the "Terra Nova" material we received nineteen tubes of tow-nettings taken by Scott in his previous voyage on the "Discovery," and properly preserved in spirit. These were all taken in the extreme South, and though examined with interest, yielded no pelagic Foraminifera. This was not unexpected, as they were taken in the immediate neighbourhood of land and under circumstances in which one would hardly expect to find pelagic Foraminifera, even under favourable climatic conditions. They proved to be diatomaceous gatherings principally, although some of the tubes contained almost pure gatherings of Peridiniaceae.

The "Discovery" material came from the following localities—no station numbers furnished:—

Jan. 9,	1902.	Robertson Bay.
Jan. 11,	1902.	Ross Sea.
Jan. 25,	1902.	Barrier of Ross.
Feb. 20,	1902.	Winter Harbour.
June 10,	1902.	,, ,,
Jan. 31,	1903.	,, ,,
March 22,	1903.	,, ,,
June 1,	1903.	Winter Quarters, No. 8 hole, 10 metres.

Nov. 2.	1903.	Winter Quarters. No. 12 hole, 10 fathoms.
Dec. 14,	1903.	Winter Harbour, Hut Point.
Jan. 1,	1904.	,, ,,
Jan. 12.	1904.	,, ,, Hut Point.
Jan. 31,	1904.	,, ,, ,, ,,
Feb. 18.	1904.	Coaling Harbour, McMurdo Strait.
Feb. 19.	1904.	Erebus Bay.
Feb. 22.	1904.	North of Wood Bay.
Feb. 23,	1904.	S.E. of Foulman Island.
Feb. 24.	1904.	Possession Islands.
Feb. 25,	1904.	Cape Adare—Cape North.

(v.) CLASSIFICATION ADOPTED IN THIS REPORT.

In our recent paper upon *Verneuilina polystropha* (H.A. and E. 1920, V.P., p. 177) we took occasion, in agreement with Bütschli and others, to say: "It seems to us that the various systems of classification which have successively been suggested, and accepted, are more or less artificial and unscientific. Taking a single example, it seems to us that the whole of the Lituolidae should be redistributed among their hyaline and porcellanous isomorphs." We avail ourselves of the opportunity afforded us by the publication of this Report, comprising as it does between six and seven hundred recognised species and varieties, and, in addition, by the fact that we have found and described arenaceous isomorphs of several hyaline species which have not, so far as we know, been recorded as exhibiting isomorphism, to express our views more fully. We do not think the time has yet arrived to abandon the generally accepted, if artificial, system of Brady, which, with some modifications, is followed in this Report. But we have endeavoured to clear the way towards a proper zoological allocation of the Lituolidae by refraining wherever possible from the creation of new arenaceous species, and retaining our new arenaceous forms in the genera to which they naturally belong, treating them as mere variations of an existing calcareous species and always under the varietal name "var. *arenacea*." We have also supplemented this step by liberal references to previously-recorded isomorphic species throughout the Report, but it must not be assumed that these references are in any way complete or even include a majority of the instances of isomorphism which could be found in the literature of the Group.

To explain fully the position, a brief résumé of the history of the Lituolidae seems necessary. Until 1862 no intensive attention had been paid to the arenaceous Foraminifera as such, and it was not until that year that many species which had been included by authors, from d'Orbigny onwards, among the so-called Perforata, were removed from the positions assigned to them and included in the

new family to which Carpenter, Parker and Jones in their "Introduction" (C., P. and J., 1862, I.S.F., p. 140) gave the name of Lituolida. Their explanation of the matter is as follows:—

The family Lituolida "is distinguished from all other types of Foraminifera by this circumstance—that whereas we find, both in the porcellanous and in the vitreous series, that the individuals of particular genera occasionally exhibit an arenaceous incrustation, this is simply an addition to the calcareous shells proper to their respective types, and is not a substitute for it—whilst in these arenaceous types the investment of the body, although presenting the regular conformation of a calcareous shell, is really a 'test' composed of an aggregation of particles obtained from external sources, the organic cement by which these particles are united being all that is furnished by the animal."

The innovation was by no means accepted without reserve by the workers upon the group. Brady, in his preliminary paper upon the Reticularian Rhizopods of the "Challenger" Expedition (B. 1879, etc., R.R.C., p. 23) reviews the situation, and, after stating the position taken up by Carpenter, Parker and Jones, goes on to say:—"Professor Reuss, writing about the same time, whilst admitting the difficulties of the position, proposes to divide the somewhat unwieldy group included in the genus *Lituola* of English systematists; and, as a matter of convenience, there was even then, no doubt, much to be said in favour of his view. In his latest work, published after his death* he divides the family Lituolidea of the 'Introduction' into four genera. . . . It will, however, become manifest as we proceed, that neither of these schemes are any longer applicable to the purpose for which they were devised, and the more recent suggestions of Professor Zittel (Z. 1876, H.P.) and Professor Rupert Jones† scarcely satisfy the exigencies of the present position."

On p. 28 he elaborates these observations in a passage too long to quote, but which is very germane to the question we are discussing.

The first real note of alarm was sounded by Bütschli in 1880 in Bronn's "Klassen und Ordnungen des Thier-reichs." (Vol. I, Protozoa, Leipzig, 1880, p. 193), where he says:—

"We assemble here a series of sandy-shelled Rhizopods, to some extent very incompletely understood, mostly monothalamous, but also at times of polythalamous construction. The assemblage (or association) of these forms is quite provisional, and depends upon, or results only from, the fact that up till now it does not appear possible to arrange them naturally in any other way, and we share the opinions frequently pronounced and expressed by others, that

* In Geinitz. Das Elbthalgebirge in Sachsen. Palaeont. vol. xx. Pt. 1. 1871–5. p. 119.
† Monthly Micr. Journ., Feb., 1876. p. 89.

Carpenter's group of sandy-shelled forms, the family Lituolidae, cannot be upheld and maintained. It will therefore form the task of the future to establish the kindred relationships of the forms belonging to this group, namely, their ascription to Imperforata or Perforata, in a manner more precisely isolated."

And in his systematic arrangement he adumbrates his departure (or reversion) in such entries as (*e.g.*) "Gruppe, Miliolida, Carpenter, emend. Bütschli (Miliolida, Carpenter, 1862 + pars. Lituolidarum, Carpenter). So, in his list, *Ammodiscus* follows *Cornuspira* (p. 189): *Cyclammina* follows *Polystomella striato-punctata* (p. 212); *Hormosina*, *Haplostiche* and *Reophax* are placed among the Lagenidae; whilst *Psammosphaera*, *Storthosphaera*, *Thurammina* and *Sorosphaera* follow after *Globigerina*, and so on.

The position of *Trochammina*, with its relatively smooth shell, has always raised a question in the minds of students of this matter, and in 1880 Bütschli, in discussing the genus, amplifies his head-note as follows:—

"As is well known, the sandy-shelled Rhizopods were collected into only three genera by Parker, Jones and Carpenter, and placed together in the family of the Lituolidae among the Imperforata. Of these three genera *Valvulina* has established itself as certainly belonging to the Perforata in proximity to *Bulimina*; the genus Lituola has hereinbefore been commented upon. The genus Trochammina, on the contrary, embraces a great number of mono- and poly-thalamous forms, remarkably diversified in their configuration-relationships, which were only connected together on account of the finer nature of their shell-wall. These construct themselves by the putting together of fine sand-grains, which are so closely built together that the outer surface of the shell always appears smooth and sometimes indeed as if polished; the inner surface is also smooth and is never furnished with labyrinthic outgrowths. Brady has already split up this protean genus into sub-genera, *Ammodiscus*, *Trochammina*, *Hormosina*, and *Webbina*; we think that, as has already been done by von Zittel, these separated so-called sub-genera should be connected with those calcareous forms to which by their construction they most nearly approach. There remains only the so-called sub-genus *Trochammina* (since *Hormosina* will be commented upon as annexed to *Nodosaria*). These comprehensive polythalamous, rotaloid, trochoid or involute nautiloid, in their construction at times come so close to the calcareous Rotalinae, or Nonioninae, and at times to *Pullenia* and *Globigerina* and *Haplophragmium* that we are much inclined to place them among these. Since we, as yet, possess no agreed knowledge on these forms, we think that we should merely refer to their relationships, and hope that future researches upon the placing of these forms will soon be pronounced upon. It seems probable that the genus *Trochammina* might best be entirely separated."

Finally, under the heading "Arenaceous Rotalinae" (p. 207), Bütschli

observes again, "a number of the arenaceous forms, generally included in the genus *Trochammina*, should apparently be placed among the Rotalinae." *

The next serious attempt to redistribute the Lituolidae was made by Neumayr in 1887 † when he discussed previous systems of classification and the relationships of arenaceous and calcareous Foraminifera, giving a table in which he separates the Astrorhizidae properly so called, and divides all the other genera into the arenaceous and calcareous development-stages (*Entwicklungsstufe*) of four "types"—the *Cornuspira* type, the *Textularia* type, the *Lituolida* type, and the *Fusulinida* type—with the latter of which the present Report is not concerned.

This Paper he subsequently elaborated and revised in his great work "Die Stämme des Thierreiches" (Vienna and Prague, 1889, Vol. i., pp. 158–206) in which he repeats his "Tabelle." We need not analyse this lengthy treatise; it suffices to say that he makes a bold and intelligent attempt to carry out the views of Bütschli. His preliminary suggestion, however, may be cited. He disposes certain leading genera as follows:—

Arenaceous Series.	Calcareous Series.
Ammodiscus.	*Spirillina, Cornuspira.*
Webbina.	*Nubecularia.*
Nodosinella.	*Nodosaria.*
Reophax, Haplostiche.	*Nodosaria, Dentalina, Lagena.*
Haplophragmium, Trochammina, Endothyra.	*Marginulina, Cristellaria, Nonionina, Sphaeroidina, Globigerina, Rotalia.*
Cystammina.	*Allomorphina.*

Not the last word on the main issue, but the most important, and the last with which we shall introduce our classification, was uttered by Eimer and Fickert in 1899.‡ After giving Brady's definition of the family (B. 1884, F.C., p. 65) they go on to say:—"By this separation of otherwise similar arenaceous forms from their calcareous relations, Brady retrogrades into error. To employ an isolated and, indeed, quite unessential (or accidental) characteristic as the

* It may be observed in this place that the student, in considering this question of arenaceous isomorphs, cannot afford to overlook the series of papers by Josef Grzybowski, which record and figure a very large number of these, under *Reophax, Haplophragmium, Trochammina, Cyclammina, Sorosphaera*, but which are unfortunately written in Polish, which tantalises the average British worker, so far as his text is concerned. The most significant are "Otwornice czerwonych ilow z Wadowic" (Cracow, 1896), "Otwornice pokladow naftonosnych okolicy Krosna" (Cracow, 1897), "Otwornice warstw Inoceramowych okolicy Gorlic" (Cracow, 1906.) See our "References," G., 1901, O.W.L., p. 240.

† M. Neumayr, "Die natürlichen Verwandschaftsverhältnisse der schalentragenden Foraminiferen," Sitzb., K. Ak. Wiss. Wien, vol. xcv, 1887, pt. i, pp. 156–186.

‡ G. H. T. Eimer and C. Fickert, "Die Artbildung und Verwandschaft bei den Foraminiferen. Entwurf einer natürlichen Eintheilung derselben," Zeitschr. wiss. Zool., vol. lxv, pt. 4, pp. 527–636, figs.

distinguishing feature of a Family, moreover so as to separate a near relation from near relation, brings him into direct antagonism with the requirements of a natural system."*

To quote satisfactorily the main contentions of this voluminous study would occupy too much space; it must be sufficient to say that the authors review all previous systems of classification, with due regard to that of Neumayr, with whom, however, they do not altogether agree. The whole work must be considered by the student.

We should also refer to the work of M. E. Fauré-Fremiet, whose output of work upon the Foraminifera is highly significant but regrettably small. In discussing this question, to the study of which he has been led by considerations of pure Biology, he observed in 1910 †

(p. 410.) "On voit qu'une telle classification est fondée uniquement sur l'aspect extérieur de ces organismes. Il m'a semblé qu'elle était peu logique, parce qu'elle ne tenait pas compte de particularités intérieures capables *d'expliquer* ces différentes formes."

(p. 412.) "Dans ce dernier groupe (Lituolides) . . . j'aurai l'occasion de montrer une autre fois, que la forme charactéristique du test arénacé de chaque genre et de chaque espèce est expliquée précisément par la forme des loges chitineuses, laquelle est en rapport, inconnu aujourd'hui, avec le métabolisme propre à la matière vivante de cette espece."

In his view, whether a Rhizopod constructs an arenaceous or a calcareous test depends upon the action of the Mitochondria in the fixation of iron or calcium salts;‡ and in a further paper, published in the same year,§ he states his position as follows:—

"En résumé, on peut admettre que la différence la plus importante qui existe entre les Foraminifères arénacés et les Foraminifères calcaires, est moins d'ordre morphologique que d'ordre physiologique, et que ce soit le métabolisme particulier à chacun de ces formes qui, en réglant la proportion du fer et du

* A letter from C. Schlumberger lies before us as we write, dated March 3, 1895, and discussing this matter. In it he says "Nous avons fait de quelques-unes de ces organismes (arénacées) des genres particuliers mais je pense que l'Auteur de toute chose doit bien s'amuser de nos petites distinctions. Je ne veux pas dire que certaines types arénacés ne soient pas des genres spéciaux, c'est incontestable, mais je vois qu'en cherchant bien on trouvera qu'il y a peu de nos genres porcellanés ou perforés qui n'aient leur representant parmi les arénacés et, malgré tout le respect que j'ai pour le savoir de mon excellent ami Brady, je trouve que son genre *Haplophragmium* est une salade de formes dans laquelle on a fourré tout ce que l'on ne savait ou placer."

† Révision des Foraminifères arénacés," Bull. Mus. Hist. Nat. Paris, 1910, No. 7, pp. 410, 412.

‡ Le rôle des mitochondries dans l'élimination de fer chez les Rhizopodes arénacés," C. rend. Soc. Biol., Paris, vol. lxx, 1911, p. 119.

§ "La constitution du test chez les Foraminifères arénacés," Bull. Inst. Océan. Monaco, Sept. 8 1911, No. 216.

calcium dans les carbonates élaborés, détermine la structure arénacée ou non arénacée du test."

In conclusion we can only state that we are in agreement with the main conclusions arrived at, and in the following Report have endeavoured to give effect to them without abandoning Brady's system. The occurrence in the "Terra Nova" material of new arenaceous isomorphs of several calcareous forms has provided a suitable opportunity for the expression of our own views on the subject.

(vi.) NEW SPECIES AND VARIETIES RECORDED IN THIS REPORT.

Miliolina auberiana, var. *arenacea*.
,, *calcarata*.
Sigmoilina umbonata.
Ophthalmidium margaritiferum.
Dendronina arborescens.
,, ,, var. *antarctica*.
,, *limosa*.
,, ,, var. *humilis*.
Hyperammina elongata, var. *tenuissima*.
,, *novae-zealandiae* (nom. nov.).
Marsipella chapmani (nom. nov.).
Trochammina moniliformis.
Bifarina porrecta, var. *arenacea*.
Bolivina punctata, var. *arenacea*.
,, *inflata*, var. *arenacea*.
,, *variabilis*, var. *arenacea*.
,, *tortuosa*, var. *arenacea*.
,, *textilarioides*, var. *arenacea*.
Bulimina chapmani.
Gaudryina ferruginea.
Cassidulina laevigata, var. *tumida*.
,, *subglobosa*, var. *tuberculata*.
Ehrenbergina hystrix, var. *glabra*.
Verneuilina turris.
Lagena auriculata, var. *quadri-auriculata*.
,, *bicarinata*, var. *spinigera*.
,, ,, var. *villosa*.
,, *clavulus*.
,, *danica*, var. *pendulum*.

Lagena globosa, var. *lineato-punctata.*
,, *orbignyana*, var. *baccata.*
.. *scarabaeus.*
.. *scottii.*
.. *squamoso-sulcata.*
.. *stelligera*, var. *nelsoni.*
Frondicularia scottii.
Nodosaria pellita.
Globigerina cretacea, var. *eggeri.*
Discorbina calcarata.
.. *disparilis.*
,, *harmeri.*
,, *wilsoni.*
Truncatulina lobatula, var. *arenacea.*
.. *tenuimargo*, var. *alto-camerata.*
Rotalia soldanii, var. *arenacea.*
Nonionina turgida, var. *arenacea.*

II. LIST OF STATIONS (HARMER AND LILLIE).

LIST OF MATERIAL (H.-A. AND E.).

It has been found impossible in the case of the soundings and other samples containing Foraminifera to depend upon, or adhere to, the Station numbers as given in the Official List, or to their sequence. The depths given in the List are trawl and net depths, or (frequently) the Station numbers merely record the capture of birds. Again, in many instances the sounding has been made at a considerable distance from the spot indicated by the number in the list, the true position being given on the labels attached to the material as it reached us. Where this has occurred we have given the official number and locality, but our own consecutive number refers to the true position as indicated by the label, which we have appended after the official locality. Where the label locality is within a few seconds of the Station locality we have retained the latter, but have given the depth as indicated by the label. To obviate the confusion which would arise from the reiteration of Station numbers which have little or no bearing upon the samples, or cover a variety of soundings (as in the series labelled "Near 194-5") and are far from geographically consecutive, we have adopted a series of consecutive numbers running strictly from North to South. A glance at the following Table will make this quite clear.

OFFICIAL LIST OF STATIONS, IN ORDER, AND CORRESPONDING NUMBERS (H.-A. and E.), AS ADOPTED IN THIS REPORT.

Official.	H.-A. & E.	Official.	H.-A. & E.	Official.	H.-A. & E.
Débris of Polyzoa	1	194/5 C	29	260	15
E. Coast of N.Z.	7	,, D	30	262	16
90	2	,, E	31	265	17
91	3	,, F	32	270	36
96	6	,, G	33	289	39
134	5	,, H	34	291	40
144	4	,, I	35	308	56
171	18	208	10	314	54
173/4A	19	209	11	331	48
,, B	20	215	14	333	51
180	22	218	37	335	49
184	23	220	38	338	50
184 (near)	24	221	43	339	47
188 A	41	222	44	340	45
188 B, C	42	227	21	342	52
193	25	241	12	348	53
194	26	242	8	355	55
194/5 A	27	244	9	356	46
,, B	28	253	13		

III. DESCRIPTION OF THE MATERIAL EXAMINED.

No. 1.—No Station number. [Label—August, 1911. Débris of Polyzoa, etc., brought up on sounding lead off Three Kings Is., New Zealand, 90–120 fms.]

Material.—Coarse débris of Polyzoa and shell-sand with much *Polytrema*. Foraminifera abundant, but mostly dead and waterworn. Notable species: – *Miliolina bucculenta*, *Lingulina carinata*, *Spirillina novae-zealandiae*, *Pulvinulina concentrica*, *Gypsina globulus*.

No. 2.—Station 90. July 25, 1911. From Summit of Great King, Three Kings Is., S. 14° W., 8 miles, 100 fms.

Material.—Three samples, 90, 90A, 90B.

Sample 90, in spirit, stones encrusted with sessile organisms, coral rock fragments and coarse sand. Foraminifera plentiful, many sessile forms.

Sample 90A, in formalin, shell débris, fragmentary sponges and Polyzoa, sand. Foraminifera not abundant, but varied and in good condition. *Polytrema*

miniaceum and var. *alba* were abundant in both samples 90 and 90A, and yielded much information as to the life-history of the genus.

Sample 90B, dry, white sand consisting of Polyzoan débris and Foraminifera with a few rock-fragments constructed of similar material agglutinated and defying disintegration. Apparently a fossil or sub-fossil deposit, but presenting, so far as the Foraminifera are concerned, a fauna nearly identical with the recent species from this locality.

Notable species:—*Nubecularia decorata*, *N. tubulosa*, *Articulina funalis*, *Dendronina arborescens*, *Psammosphaera rustica*, *Marsipella chapmani*, *Ammodiscus shoncanus*, *Seabrookia pellucida*, *Lingulina carinata*, *Frondicularia scottii*, *F. spathulata*. *Residues*, immature Foraminifera, foraminiferal and other débris, some mineral grains, abundant and varied sponge-spicules and many Tunicate-spicules, but only a few diatoms.

No. 3.—Station 91. July 26, 1911. From summit of Great King, Three Kings Is., S. 10° W., 25 miles, 300 fms.

Material.—Two samples, 91, 91A.

Sample 91, in spirit, stones, corals and sand with Polyzoan and sponge débris and flocculent organic matter, very difficult to wash. *Sieves*:—A felt of Polyzoan and sponge-fragments mixed with Foraminifera and sand. Sample 91A, dry, was similar to sample 90B.

Notable species:—*Psammosphaera rustica*, *Thurammina papillata*, var. *haeusleri*, *Discorbina lingulata*, var. *unguiculata*, *Anomalina polymorpha*.

Residues contained abundant sponge-spicules, diatoms, immature and broken Foraminifera, with many calcareous and mineral fragments.

No. 4.—Station 144. Sept. 13, 1911. From Cape Maria van Diemen, W. by S., 7 miles, 35–40 fms.

Material.—Organic débris and sand. Very difficult to clean and yielding little of interest except *Fischerina helix*. *Residues* largely sponge-spicules and mineral grains in about equal proportions. Many immature and broken Foraminifera, diatoms and much flocculent organic débris.

No. 5.—Station 134. August 31, 1911. Spirits Bay, near North Cape, New Zealand, 11–20 fms.

Material.—Three samples, 134, 134A, 134B.

Sample 134, in spirit, shell-fragments and a little sand.

Sample 134A, in spirit, Molluscan and Polyzoan débris with mud.

Sample 134B, in spirit, fragmentary Ophiurids and other organic débris. The material was not rich, but yielded many shallow-water forms, including *Gypsina globulus* and *G. vesicularis*, both abundant and well-developed, *Spirillina novae-zealandiae* and *S. decorata* in great variety, a hispid specimen of *Polymorphina oblonga* and one of the three specimens of *Cymbalopora bulloides* obtained

from the "Terra Nova" material. *Residues* largely sponge-spicules, but immature Foraminifera were present in some numbers and diatoms in lesser proportion. Much angular mineral matter.

No. 6. Station 96. August 3, 1911. 7 miles E. of North Cape, New Zealand, 70 fms.

Material.—Five samples, 96, 96A, 96B, 96C, 96D.

Sample 96, in spirit, Molluscan and sponge-débris. Foraminifera infrequent but varied.

Sample 96A, in spirit, coarse shell-sand, Polyzoan débris, angular sand. Foraminifera varied and in fine condition, but not abundant. Many of the shells encrusted with the diatom *Navicula* (*Cocconeis*) *glacialis*, Cleve, a species common to both Arctic and Antarctic material.

Sample 96B, dry, several lumps of a white-grey limestone of organic origin, similar in appearance and origin to samples 91A and 90B.

Sample 96C, in spirit and formalin, organic débris of every kind, including many large specimens of *Polytrema*, and a little mud.

Sample 96D, in formalin, fragmentary animal remains with some muddy sand and much flocculent organic matter, very difficult to clean. Sieves yielded a few large Foraminifera and abundant and varied smaller forms.

Owing to the considerable quantity of material received it was possible to work out the fauna of this Station very completely. It yielded a very large number of species, including several new to science, also many of great rarity and interest. Notable species:—*Cornuspira diffusa*, *Iridia diaphana*, *Dendronina arborescens*, *D. limosa*, *Hyperammina novae-zealandiae*, *Jaculella acuta*, *Reophax spiculifera*, *R. cuneta*, *Nouria polymorphinoides*, *Hormosina globulifera*, *Hastigerina pelagica*, *Anomalina coronata*, *Carpenteria proteiformis*. *Residues*:—Sponge-spicules, immature and broken Foraminifera and angular mineral grains. The residues of the fossil sample 96B (as with the other fossil samples) were very scanty, almost entirely calcareous débris and immature Foraminifera, with hardly any siliceous organisms or mineral grains. These facts point to a change in the conditions under which the deposits were laid down as compared with existing conditions, although the Foraminiferal faunas are largely identical.

No. 7. No Station number. [Label:—Sounding samples off the East Coast of New Zealand, Oct., 1911.]

Material.—Soundings in formalin. No details of depth or locality. Differentiated into Samples A and B.

Sample A.—Two tubes of greenish-grey sandy mud, dried light grey and weighed about ½ ounce. Broke down readily in water. *Sieves* contained *Globigerina*, pumice and angular minerals. Notable species:—*Bulimina rostrata*. *Residues*, angular minerals, foraminiferal débris, many diatoms, a few coccoliths. No Radiolaria were observed.

Sample B.—Four tubes of dark blue-grey clay, about 1 ounce. No macroscopic organisms. Dried dark blue-grey and was refractory, splitting up into laminated flakes in water. Was dried again and broke down in a weak solution of soda. *Sieves* contained large flakes of refractory material, some pellets of clay, a few dead shells of Foraminifera, Radiolaria, sponge-spicules. *Residues*, clay pellets, angular minerals, many diatoms and sponge-spicules, a few immature Foraminifera. No coccoliths observed.

No. 8. Near Station 242. [Label:—March 31, 1912. 45° 13′ 1″ S., 172° 45′ 3″ E., 790 fms.]

Material.—A dried sounding, 4·5 c.c. nearly white mud, without macroscopic organisms. *Sieves* retained little residue, almost pure *Globigerina*, mica, fine minerals, but yielded several notable species:—*Thurammina papillata*, *Trochammina pauciloculata*, *Cyclammina orbicularis*, *Seabrookia earlandi*. *Residues*, immature and broken *Globigerina* and other Foraminifera, mica, mineral grains. Many coccoliths and diatoms.

No. 9.—Very near Station 244. [Label:—Dec. 15, 1912, 45° 41′ 6″ S., 174° 43′ E., 639 fms.]

Material.—A sounding, 1·5 c.c. pale french-grey mud in formalin. Dried white. A fine amorphous mud containing minute Foraminifera and a few mineral flakes. Hardly any residue on sieves, mostly *Globigerina* and mica. Notable species *Bolivina beyrichi*, *Discorbina millettii*, *Truncatulina robertsoniana*. *Residues*, minute and broken Foraminifera, diatoms, minerals, many coccoliths.

No. 10.—Near Station 208. [Label:—49° 26′ 3″ S., 172° 04′ 3″ E., 138 fms.]

Note:—The constituent organisms indicate a greater depth, the label may possibly be incorrect as regards depth.

Material.—A sounding, in spirit, 12 c.c. of white ooze with abundant Globigerinae and other Foraminifera, very little mineral matter. Almost a pure foraminiferous deposit. Notable species:—*Hyperammina elongata*, var. *laevigata*, *Clavulina cylindrica*, *Bolivina robusta*, *Lagena* abundant and varied. *Residues*, a very fine calcareous mud, chiefly immature and broken down Foraminifera. Very few minerals, diatoms or coccoliths.

No. 11.—Near Station 209. [Label:—Dec. 19, 1911, 51° 30′ 4″ S., 172° 12′ E., 289 fms.]

Material.—12 c.c. dry white ooze, with a large proportion of amorphous carbonate of lime, and hardly any other mineral matter. Tenacious when wet. *Uvigerina* varied and abundant. Notable species:—*Frondicularia inaequalis*, *Sagrina dimorpha*, *Ramulina globulifera*, *Anomalina sinuosa*. *Residues* contained minute and comminuted *Globigerina*, much amorphous carbonate of lime, many coccoliths.

No. 12.—Near Station 241. [Label:—March 29, 1912, 50° 11′ S., 169° 08′ E., 301 fms.]

Material.—A sounding, in spirit, 13 cc. dirty-white ooze, *Globigerina* and other Foraminifera in a dense calcareous mud. Notable species:—*Biloculina depressa*, var. *serrata*, *Bulimina echinata*. *Residues* contained abundant immature *Globigerina*, other Foraminifera, and coccoliths, many fine mineral particles, a few sponge-spicules.

No. 13.—Very near Station 253. [Label:—Dec. 21, 1912, 54° 37′ 9″ S., 176° 24′ 2″ W., 3,003 fms.]

Material.—Three soundings, in formalin, about 27 c.c. pale brown ooze of mixed radiolarian and diatom origin. Dried buff colour. *Sieves* contained Radiolaria, some large, sand-grains both rounded and angular, a few arenaceous Foraminifera, but hardly any calcareous organisms. Notable species:—*Spiroloculina tenuis*, *Thurammina papillata*, var. *castanea* and var. *albicans*, *Haplophragmium anceps*, *H. sphaeroidiniforme*. *Residues* largely diatom and radiolarian débris, angular minerals, some sponge-spicules.

No. 14.—Near Station 215. [Label:—Dec. 26, 1911, 63° 59′ S., 174° 13′ W., 1,801 fms.]

Material.—A sounding, in formalin, 1·5 c.c. of creamy yellow diatom ooze. The sieves contained only a few *Globigerina* and other Foraminifera in a felted mass of Radiolaria and diatoms. The only notable species was *Lagena plumigera*. *Residues*:—Radiolaria and diatoms in all stages of comminution.

No. 15. -Very near Station 260. [Label:—62° 20′ 4″ S., 167° 45′ W., 1,627 fms.]

Material.—A sounding, in formalin, 3 c.c. light buff diatom ooze, drying white. *Sieves* contained a few *Globigerina* and other Foraminifera, Radiolaria, diatoms, a few Hexactinellid spicules and angular minerals. Notable species:—*Miliolina oblonga* and *Reophax distans*. *Residues* consisted of diatoms, Radiolaria and minute *Globigerina*, but practically no mineral particles.

No. 16.—Very near Station 262. [Label:—Dec. 26, 1912, 64° 33′ 4″ S., 166° 30′ W., 1,600 fms.]

Material.—Three soundings, in formalin, estimated 36 c.c. pale brown ooze, drying cream colour, consisting of *Globigerina* and abundant other Foraminifera, Radiolaria, minerals (some rounded) in a diatomaceous mud. Notable species:—*Cyclammina orbicularis*, *Seabrookia earlandi*, *Lagena exsculpta*, *L. aspera*, *L. hispida*, *L. plumigera*, *Polymorphina longicollis*, *Sagrina virgula*. *Residues*, a fine mud, largely diatomaceous, some Radiolaria, and immature Foraminifera, fine angular minerals.

No. 17.—Very near Station 265. [Label:—Dec. 27, 1912, 66° 29′ 8″ S., 166° 8′ W., 1,894 fms.]

Material.—13 c.c. pale brown ooze sounding, in formalin, dried yellowish cream. Tenacious and difficult to clean. *Sieves* contained *Globigerina* and other Foraminifera, Radiolaria (chiefly Sphaerellaria) a few angular minerals. Notable species:—*Seabrookia earlandi*, *Polymorphina lanceolata*, many *Lagena* including *L. danica*, *L. foveolata*, *L. longispina*, *L. seminuda*. *Residues*, amorphous impalpable mud, with immature Foraminifera, Radiolaria, diatoms, much calcareous débris.

No. 18.—Station 171. [Label:—Dec. 10, 1910, 66° 38′ S., 178° 47′ W., 1,964 fms.]

Material.—12 c.c. brown mud sounding, in spirit, dried light grey. *Sieves*:—*Globigerina* and other Foraminifera and débris of the same with Radiolaria, diatoms and a few angular minerals. Notable species:—*Sigmoilina ovata*, *Ammodiscus charoides*, *Ehrenbergina hystrix*, many species of *Lagena*, *Pulvinulina pauperata*. *Residues* almost entirely organic, *Globigerina* and diatom débris, Radiolaria, very fine minerals.

No. 19.—Near Stations 173–174. Sounding A. [Label:—Dec. 11, 1910, 66° 55′ S., 178° 51′ W., 2,015 fms.]

Material.—About 6 c.c. light brown ooze sounding, in spirit, dried very pale brown, broke down readily. An ooze of mixed *Globigerina*, diatom and mineral origin. *Sieves* contained thick-walled dead *Globigerina*, many other Foraminifera, a few mineral grains, some being large, many small pellets of clay which had resisted disintegration. Notable species:—*Biloculina elongata*, *Miliolina tricarinata*, *Cyclammina pusilla*, *Sphaeroidina bulloides*. *Residues* contained fragmentary and immature *Globigerina*, diatoms, fine minerals, amorphous pellets of clay.

No. 20.—Near Stations 173–174. Sounding B. [Label:—Dec. 13, 1910, 67° 30′ 1″ S., 177° 57′ 1″ W., 2,131 fms.]

Material.—15 c.c. brown ooze, in spirit, dried pale grey, and did not readily disintegrate. Dried again and broke down in weak soda into a fine homogeneous mud of mineral and diatom origin. *Sieves* contained *Globigerina* and other Foraminifera, angular minerals. Notable species:—*Ammodiscus charoides*, various *Lagena*. *Residues*, angular minerals, immature and broken Foraminifera, diatoms, Radiolaria, sponge-spicules.

No. 21.—Near Station 227. [Label:—March 14, 1912, 68° 45′ S., 172° 38′ E., 1,749 fms.]

Material.—A sounding, 12 c.c. pale brown clay in formalin, dried grey, tenacious and difficult to wash even after drying. *Sieves* contained many mineral grains of varying sizes, abundant sponge-spicules and diatoms, a few Radiolaria, and very few Foraminifera. Notable species:—*Thurammina papillata*, var. *albicans*,

Ammodiscus charoides, *Cyclammina pusilla*. *Residues*, a fine mud of minerals, diatoms, sponge-spicules with a few Radiolaria.

No. 22.—Near Station 180. [Label:—Dec. 20, 1910, 68° 40′ 5″ S., 179° 27′ 7″ W., 1,802 fms.]

Material.—A sounding 13·5 c.c. yellowish brown mud, in spirit, dried light grey and broke down readily. *Sieves* contained *Globigerina* and other Foraminifera with angular minerals of varying sizes in about equal proportions, also many Radiolaria, a few diatoms and sponge-spicules. Notable species:—*Marsipella cylindrica*, *Reophax difflugiformis*, *Haplophragmium sphaeroidiniforme*, *Bolivina decussata*, varied *Lagena*. *Residues*, *Globigerina* débris, minerals, Radiolaria and diatoms, the finest residue largely diatomaceous.

No. 23.—Station 184. [Label:—Dec. 26, 1910, 69° 08′ 8″ S., 178° 12′ 7″ W., 1,816 fms.]

Material.—A sounding, 12 c.c. pale brown mud in spirit, dried very pale brown, but did not break down in water. Dried again and broke down in weak soda into an impalpable mud of mineral origin. *Sieves* contained abundant angular mineral grains, some large with sessile organisms, *Globigerina* and other Foraminifera, clay pellets, some sponge-spicules, and a few diatoms. Notable species:—*Spiroloculina tenuis*, *Cyclammina pusilla*, varied *Lagena*, *Nodosaria raphanistrum*. *Residues*, heavy clay-pellets and angular minerals, foraminiferal débris, diatoms.

No. 24. Near Station 184. [Label:—Dec. 28, 1910, 69° 16′ 6″ S., 179° 43′ 2″ W., 2,035 fms.]

Material.—A sounding, 15 c.c. light brown clay, in spirit, dried light grey and did not break down in water. Dried again it broke down into layers. Dried once more it broke down in weak soda into a fine mud of mixed mineral and organic origin, still exhibiting a tendency to cohere into pellets. *Sieves* contained angular minerals of varying sizes, some large, sponge-spicules, clay-pellets, a few large diatoms and Radiolaria but practically no Foraminifera, the only species recorded being *Psammosphaera fusca*, *Haplophragmium latidorsatum*, *Cyclammina pusilla*, *Globigerina dutertrei*. *Residues*, mineral particles cohering into pellets, diatoms.

No. 25. Near Station 193. [Label:—Feb. 22, 1911, 68° 41′ 6″ S., 165° 57′ E., 1,435 fms.]

Material.—A sounding, 12 c.c. of tenacious brown clay with dark specks, in spirit. Dried light grey and broke up into a fine mud of mineral and diatom origin with abundant sponge-spicules and some Radiolaria, but very few Foraminifera. Notable species:—*Cyclammina pusilla*, *Reophax difflugiformis*, *Haplophragmium tenuimargo*, *Hormosina globulifera*, *Trochammina trullissata*, *T. rotaliformis*. *Residues*, diatoms and diatomaceous débris, sponge-spicules, Radiolaria, minerals.

No. 26. Station 194. [Label: Feb. 22, 1911, 69° 43′ S., 163° 24′ E., off Oates Land, 180-200 fms.]

Material.—A small tube of selected Foraminifera and considerable quantity of zoophytes, Polyzoa and sandy débris in formalin, also similar material with mud in spirit. Very difficult to clean, the sieves retaining a felted mass of sponge and Polyzoan débris which required to be broken up with a brush. Foraminifera plentiful, but in poor condition, many sessile forms, notably *Truncatulina refulgens*, abundant on the Polyzoa. *Wagnerella borealis* (Heliozoa) was observed. Notable species: *Miliolina bucculenta*, *Miliolina oblonga*, var. *arenacea*, *Articulina funalis*, *Cornuspira selseyensis*, *Astrorhiza limicola*, *Dendronina limosa*, var. *humilis*, *Iridia diaphana*, *Sorosphaera confusa*, *Crithionina pisum*, *C. granum*, *Reophax distans*, *Haplophragmium crassimargo*, *H. canariense*, var. *variabilis*, *H. nanum*, *Ammodiscus shoneanus*, *Bulimina chapmani*, *Ehrenbergina hystrix*, var. *glabra*. *Residues* contained angular minerals, sponge-spicules, diatoms, immature Foraminifera, chiefly Arenacea.

No. 27. Near Station 194. Sounding A. [Label:—Feb. 22, 1911, 69° 4′ S., 163° 24′ E., 178 fms.]

Material.—12 c.c. grey-brown mud, in spirit, easily cleaned. *Sieves* contained mineral grains of all sizes, abundant Foraminifera, sponge-spicules, diatoms. Notable species:—*Miliolina oblonga*, var. *arenacea*, *Haplophragmium glomeratum*, *Bulimina subteres*, *B. chapmani*, *Cassidulina nitidula*, *Frondicularia pygmaea*, *Marginulina glabra*. *Residues* consisted of fine minerals, immature Foraminifera, diatoms, sponge-spicules and abundant amorphous particles (? volcanic ash).

No. 28. Near Station 194. Sounding B. [Label:—Feb. 22, 1911, 69° 14′ 5″ S., 164° 24′ 2″ E., 1,177 fms.]

Material.—12 c.c. tenacious chocolate clay, in spirit, dried light grey and broke down into flakes like a true clay. Dried again it broke down into a fine mud principally diatomaceous, fine minerals, sponge-spicules. Foraminifera rare, almost entirely Arenacea. Notable species:—*Reophax difflugiformis*, *R. distans*, *Haplophragmium foliaceum*, *Hormosina globulifera*, *Ammodiscus charoides*, *Cyclammina pusilla*. *Residues* contained fine minerals, abundant sponge-spicules, diatoms, and some Radiolaria.

No. 29. Near Station 194. Sounding C. [Label:—Feb. 23, 1911, 69° 29′ 5″ S., 162° 49′ 4″ E., 951 fms.]

Material.—12 c.c. grey-brown mud, in spirit. *Sieves* contained dark mineral grains, both rounded and angular, a few Foraminifera, and Radiolaria, abundant sponge-spicules and diatoms. Notable species:—*Bathysiphon filiformis*, *Hyperammina elongata*, var. *laevigata*, *Placopsilina cenomana*, *Haplophragmium globigeriniforme*, *Ammodiscus charoides*, *Cyclammina orbicularis*, *Spiroplecta annectens*. *Residues*, angular minerals, abundant sponge-spicules, diatoms.

No. 30. Near Stations 194-195. Sounding D. [Label: Feb. 23, 1911, 69° 15′ S., 161° 58′ E., 245 fms.]

Material.—9 c.c. dark grey sandy mud, in spirit, dried light grey. *Sieves* contained angular and sub-rounded minerals of all sizes, but hardly any organisms, except a few Foraminifera, sponge-spicules and diatoms. Notable species: *Miliolina seminulum*, *Virgulina subsquamosa*, *Cassidulina subglobosa*, var. *tuberculata*. *Residues* consisted of fine mineral grains with practically no organic constituents.

No. 31. Near Stations 194-195. Sounding E. [Label: Feb. 26, 1911, 68° 51′ 7″ S., 158° 34′ E., 268 fms.]

Material.—4·5 c.c. light grey muddy sand in spirit. *Sieves* contained fine minerals, many sponge-spicules, a few Foraminifera. Notable species:—*Biloculina irregularis*, *Bulimina echinata*, *Seabrookia earlandi*, *Lagena exsculpta*, *Spirillina tuberculata*. *Residues* consisted of fine minerals, sponge-spicules, a few minute Foraminifera, diatoms.

No. 32. Near Stations 194–195. Sounding F. [Label:—Feb. 27, 1911, 68° 46′ S., 158° 57′ E., 1,165 fms.]

Material.—15 c.c. pale chocolate mud, in spirit, dried pale brown. *Sieves* contained clay-pellets, sponge-spicules, Foraminifera, diatoms, Radiolaria and minerals. Notable species:—*Reophax longiscatiformis*, *Haplophragmium foliaceum*, *H. agglutinans* (very long and pauperate), *H. glomeratum*, *Cyclammina pusilla*, *C. orbicularis*, *Placopsilina cenomana*. *Residues* consisted of minerals and diatoms in about equal proportions with abundant sponge-spicules.

No. 33. Near Stations 194–195. Sounding G. [Label:—March 4, 1911, 67° 6′ 5″ S., 160° 53′ 8″ E., 1,448 fms.]

Material.—12 c.c. very tenacious pale chocolate clay, in spirit. Dried pale grey and broke down readily in water but proved difficult to clean. *Sieves* contained diatoms, Radiolaria, sponge-spicules, clay-pellets, a few mineral grains and very few Foraminifera. Notable species:—*Haplophragmium glomeratum*, *H. foliaceum*, *H. scitulum*, *Trochammina nitida*, *Clavulina communis*, *Spiroplecta annectens*. *Residues* consisted of clay-pellets and minerals, with abundant diatoms and sponge-spicules.

No. 34. Near Stations 194–195. Sounding H. [Label: March 4, 1911, 66° 43′ 8″ S., 161° 9′ E., 1,502 fms.]

Material.—10·5 c.c. homogeneous dark brown clay, in formalin, dried pale grey. Broke down readily in water into flocculent pieces which resisted further disintegration. *Sieves* contained clay-pellets, mineral grains of varying sizes (one very large), Radiolaria, sponge-spicules, diatoms and very few Foraminifera. Notable species:—*Reophax difflugiformis* and *Trochammina robertsoni*. *Residues*

consisted of clay-pellets, minerals, Radiolaria, sponge-spicules, and abundant diatoms.

No. 35. Near Stations 194–195. Sounding 1. [Label: March 5, 1911, 66° 06′ 1″ S., 161° 09′ 2″ E. 1,668 fms.]

Material.—12 c.c. pale chocolate mud with dark grains, in formalin, dried grey and washed easily. *Sieves* contained dark minerals, abundant Radiolaria and diatoms and a few Foraminifera. Notable species:—*Reophax difflugiformis*, *R. distans*, *Trochammina robertsoni*, *T. pauciloculata*. *Residues* consisted of diatoms, Radiolaria and fine minerals.

No. 36.—Station 270. [Label:—Dec. 29, 1912, 69° 51′ S., 166° 17′ W., 2,216 fms.]

Material.—A sounding, 13·5 c.c. pale brown ooze, in formalin, dried cream colour, tenacious and difficult to clean. *Sieves* contained a pebble, large angular minerals, clay-pellets, diatoms, *Globigerina* and other Foraminifera. Notable species: *Biloculina depressa*, var. *murrhyna*, *Spiroloculina tenuis*, very varied Lagenae, *Nodosaria calomorpha*, *N. mucronata*, *N. raphanistrum*, *Discorbina chasteri*. *Residues* consisted of minute minerals, diatoms, immature *Globigerina*.

No. 37.—Near Station 218, Cape Adare (?). [Label:—Near 218 (?), 65° 30′ 6″ S., 176° 27′ 7″ W., 1,120 fms.]

Material.—A sounding, 2 c.c. pale fawn mud, in formalin. *Sieves* contained a felted mass of Radiolaria and diatoms, a few angular sand-grains and Foraminifera, but none of note. *Residues* consisted of diatoms and Radiolaria.

No. 38.—Station 220. [Label: Jan. 3, 1912, Off Cape Adare, mouth of Robertson's Bay, 45–50 fms.]

Material.—Organic débris, principally Hydrozoan fragments mixed with black pebbles and sand, difficult to clean. *Sieves* contained a felted mass of Hydrozoan débris, diatoms (*Triceratium*), sponge-spicules and basaltic sand with abundant spherical bodies (? Zeolites), a few Foraminifera. Notable species:—*Crithionina pisum*, *C. rugosa*, var. *hispida*, *Bulimina chapmani*, *Cassidulina parkeriana*, *Ehrenbergina hystrix*, var. *glabra*, *Discorbina chasteri*. The Heliozoan *Wagnerella borealis* was also noted. *Residues* consisted of diatoms, sponge-spicules, angular minerals and a few immature Foraminifera.

No. 39. Station 289. [Label:—Jan. 12, 1913, 72° S., 168° 17′ 5″ W., 2,322 fms.]

Material.—A sounding 4·5 c.c. light brown plastic mud, dried whitey-grey, very refractory. *Sieves* contained only 0.3 c.c. grey residue of pellets and flakes of clay, and a few mineral grains, and very few Radiolaria. The only Foraminifera recorded were *Cyclammina pusilla* (3), *Haplophragmium latidorsatum* (1),

Webbina clavata (1), all starved specimens. *Residues* consisted of extremely fine mineral particles, with a few diatoms and sponge-spicules.

No. 40.—Station 291. [Label: Jan. 14, 1913, 72° 40′ 9″ S., 172° 37′ 5″ W., 1,917 fms.]

Material.—Soundings, 28 c.c. of light brown-grey mud, in formalin, dried nearly white and difficult to wash. *Sieves* retained only 1·25 c.c. of angular minerals, sponge-spicules, diatoms and Radiolaria with a few Foraminifera. Notable species:—*Reophax ampullacea, R. difflugiformis, Thurammina papillata, Trochammina pauciloculata, Ammodiscus shoneanus. Residues*, almost entirely diatomaceous with some Radiolaria and fine minerals.

No. 41.—Near Station 188. Sounding A. [Label:—Jan. 2, 1911, 75° 9′ 7″ S., 173° 39′ 8″ E., 251 fms.]

Material.—10·5 c.c. light olive brown mud, in formalin, dried greenish white. *Sieves* contained angular minerals, sponge-spicules, Radiolaria, abundant diatoms, but very few Foraminifera. Notable species:—*Miliolina oblonga*, var. *arenacea, Psammosphaera rustica, Reophax spiculifera, R. longiscatiformis, Bolivina punctata*, var. *arenacea. Residues* consisted almost entirely of diatoms and Radiolaria, with some sponge-spicules and minerals.

No. 42. Near Station 188. Sounding B. [Label: Jan. 2, 1911, 74° 24′ 7″ S., 174° 1′ 3″ E., 313 fms.]

Material.—12 c.c. of pale grey brown mud with darker grains, in formalin. Very tenacious and refractory, splitting up in water into flocculent layers as though stratified. Dried again it broke down in soda into a clay-like mud. *Sieves* contained angular minerals, some large, Radiolaria, a few sponge-spicules and diatoms, and very few Foraminifera. Notable species:—*Haplophragmium anceps, Ammodiscus charoides, Cyclammina pusilla, Trochammina rotaliformis, Clavulina communis. Residues* consisted of minerals, sponge-spicules, diatoms and minute irregular pellets of clay in all stages of disintegration into their constituents, a débris of fine mineral, Radiolarian and diatom-fragments.

No. 43.—Near Station 221. [Label:—Jan. 8, 1912, 75° 25′ S., 165° 11′ E., 400 fms.]

Material.—A sounding, 10·5 c.c. of slate-brown mud with dark mineral grains, in formalin, dried very light grey. *Sieves* contained angular minerals, many sponge-spicules and Radiolaria, abundant diatoms, but very few Foraminifera. Notable species:—*Miliolina oblonga*, var. *arenacea, Haplophragmium scitulum, H. anceps. Residues* consisted of angular minerals, sponge-spicules, and abundant diatoms.

No. 44.—Station 222. [Label:—Jan. 10, 1912, 76° 02′ 7″ S., 165° 55′ 2″ E., 303 fms.]

Material.—A sounding, 12 c.c. of yellow-grey diatom ooze, with many dark mineral grains, in formalin, dried light grey. *Sieves* contained dark rounded minerals, sponge-spicules and Foraminifera. Notable species:—*Bathysiphon argenteus*, *Haplophragmium fontinense*, *H. glomeratum*, *Trochammina trullissata*. *Residues* consisted of diatoms and sponge-spicules.

No. 45.—Station 340. Jan. 25, 1912, 76° 56′ S., 164° 12′ E., 160 fms.

Material.—Débris of Polyzoa, Echinoderms and Sponges with a small quantity of muddy sand, in spirit. Difficult to clean. *Sieves* contained a felt of débris with rounded minerals, diatoms, sponge-spicules and Foraminifera. Notable species:—*Dendronina arborescens*, var. *antarctica*, *Rhizammina algaeformis*, *Crithionina pisum*, *Reophax advena*, *Thurammina papillata*, var. *haeusleri*. *Residues* consisted of minerals, abundant diatoms and sponge-spicules, and many immature Foraminifera.

No. 46.—Station 356. Jan. 22, 1913, off Granite Harbour, entrance to McMurdo Sound, 50 fms.

Material.—Organic débris with a little sand, in spirit, difficult to clean. *Sieves* contained a felted mass of sponge-fragments and spicules, with scanty Foraminifera. Notable species:—*Haplophragmium nanum*, *H. canariense*, var. *variabilis*, *Thurammina papillata*, var. *haeusleri*, *Bulimina chapmani*, *Cassidulina parkeriana*, *Ehrenbergina hystrix*, var. *glabra*. A small Pycnogonid was observed bearing sessile specimens of *Ammodiscus gordialis* (many) *Trochammina squamata*, *Discorbina globularis* and *Truncatulina refulgens*. *Residues* consisted of diatoms, sponge-spicules and minerals.

No. 47.—Station 339. Jan. 24, 1912, 77° 5′ S., 164° 17′ E., 140 fms.

Material.—Polyzoan and Echinoderm débris with a little black sand, in formalin. Difficult to clean. *Sieves* contained a felt of débris, but very few Foraminifera except *Truncatulina refulgens*, which was abundant. Notable species:—*Reophax longiscatiformis*, *Thurammina papillata*, var. *haeusleri* and *Patellina corrugata*, showing development of young individuals in basal cavity. *Residues* consisted of dark angular minerals, a few sponge-spicules and diatoms, and very few immature Foraminifera.

No. 48.—Station 331. Jan. 14, 1912. Off Cape Bird Peninsula, entrance to McMurdo Sound, 250 fms.

Material.—Sand and organic débris in spirit, similar material in formalin, and a few selected Foraminifera. *Sieves* contained a mass of Echinoderm, Polyzoan, Hydrozoan and sponge débris, with black volcanic sand. Foraminifera poorly represented except *Cassidulina*, very common. Notable species:—*Miliolina calcarata*, *Iridia diaphana*, *Pelosina cylindrica*, *Ammodiscus shoneanus*. A specimen of *Truncatulina lobatula* containing embryo shells was recorded. *Residues* consisted of angular minerals, volcanic ash, sponge-spicules in great abundance, diatoms, and a few immature Foraminifera.

No. 49.—Near Station 335. Jan. 20, 1912, 77° 10′ 8″ S., 164° 13′ E., 187 fms.

Material.—A sounding, 9 c.c. of dark olive sandy mud, in formalin, dried grey. *Sieves* contained dark minerals, Polyzoan and Annelid débris, abundant sponge-spicules and diatoms, very few Foraminifera. Notable species:—*Reophax dentaliniformis* and *Operculina ammonoides*. *Residues* consisted of minerals, rounded and angular, abundant diatoms and sponge-spicules, a few Radiolaria.

No. 50.—Station 338. Jan. 23, 1912, 77° 13′ S., 164° 18′ E., 207 fms.

Material.—Corallines encrusted with *Truncatulina refulgens*, coralline- and sponge-débris, much organic flocculent matter, mud and fine black rounded volcanic sand, in formalin. Difficult to wash. *Sieves* contained a felt of débris. Foraminifera fairly numerous, but more or less decalcified by the formalin. Notable species: *Miliolina oblonga*, var. *arenacea*, *M. calcarata*, *Iridia diaphana*, *Reophax dentaliniformis*, *Thurammina papillata*, var. *favosa* (compressed type). *Residues*, dark angular minerals, sponge-spicules, diatoms, a few immature Arenacea.

No. 51.—Station 333. Jan. 17, 1912, 77° 22′ 5″ S., 165° 22′ E., 418 fms.

Material.—A sounding, 12 c.c. dark olive green (almost black) mud, in formalin, dried white-grey with a green tinge. *Sieves* contained rounded and angular minerals, some Radiolaria, sponge-spicules and a few Foraminifera in poor condition, all Arenacea except *Miliolina oblonga*, var. *arenacea*, which itself is of adventitious construction. How far the formalin was responsible for the entire absence of calcareous forms is unknown. *Residues* almost entirely diatomaceous, with some sponge-spicules and minerals.

No. 52.—Station 342. Jan. 31, 1912, 77° 36′ S., 165° 30′ E., 416 fms.

Material.—Soundings, 18 c.c. dark olive mud with darker grains, in formalin, dried light grey, and proved very refractory. *Sieves* contained angular minerals, lumps of grey mud resisting disintegration, many sponge-spicules, Radiolaria and diatoms, very few Foraminifera, principally Arenacea. Notable species:—*Miliolina oblonga*, var. *arenacea*, *Reophax dentaliniformis*, *Bolivina punctata*, var. *arenacea*, *Verneuilina pusilla*. *Residues*, diatoms with angular minerals, sponge-spicules and Radiolaria.

No. 53.—Station 348. Feb. 13, 1912, off Barne Glacier, McMurdo Sound, 200 fms.

Material.—Polyzoan and other organic débris and muddy sand, in formalin. *Sieves* contained débris, sponge-spicules, diatoms, a few minerals, a few Foraminifera, mostly small. Notable species:—*Iridia diaphana*, *Thurammina papillata*, var. *haeusleri*, *Bulimina chapmani*, *Discorbina cliasteri*. *Residues*, diatomaceous with some sponge-spicules, a few minerals and minute Foraminifera.

No. 54. Station 314. Jan. 23, 1911, 5 miles North of Inaccessible Island, McMurdo Sound, 222-241 fms. [Label: Jan. 23, 1911, McMurdo Sound.]

Material.—Originally in spirit, but dried into a hard cake of mud and sand, which did not readily disintegrate. *Sieves* contained a felt of sponge-spicules, diatoms. Foraminifera varied, but not abundant, except *Cassidulina subglobosa*, *C. crassa*, *Ehrenbergina hystrix*, var. *glabra* and *Uvigerina angulosa*. *Residues* consisted of angular minerals, volcanic ash, abundant sponge-spicules and diatoms, a few minute Foraminifera.

No. 55.—Station 355. Jan. 20, 1913, 77° 46′ S., 166° 8′ E., 300 fms.

Material.—Organic débris, mud and sand, in a mixture of spirit and formalin. Very difficult to clean. *Sieves* contained Sponge, Alcyonarian and Hydroid débris, with angular minerals and some Foraminifera. *Truncatulina refulgens* predominating. Notable species:—*Psammosphaera rustica*, *Vernenilina pusilla*, *Bulimina chapmani*, *Cassidulina bradyi*, var. *elongata*, *Lingulina biloculi*, *Spirillina obconica*, and var. *carinata*, *Patellina corrugata*. *Residues* consisted of minute minerals, sponge-spicules, diatoms and a few Foraminifera, mostly immature.

No. 56.—Station 308. April 9, 1913 (To West of Tierra del Fuego), 55° 29′ S., 78° 54′ W., 2,356 fms.

Material.—A sounding, 10·5 c.c., pale brown ooze, in spirit, dried cream colour. Globigerinidae and Radiolaria in a diatomaceous mud. *Sieves* contained Foraminifera and Radiolaria, mostly dead and opaque shells, débris of the same, diatoms, a few angular minerals. Notable species:—*Aschemonella catenata*, *Spiroplecta biformis* and *Pleurostomella subnodosa*. *Residues* consisted of diatoms and Radiolaria and a few minerals.

IV. SPECIES AND VARIETIES RECORDED.

By the time this Report was ready for impression the cost of paper and printing had reached the point which is recorded for all time in the aspect of the Scientific Journals of to-day. The Director, whilst giving us practically a free hand, appealed to us to meet this situation. Apart from compression of the Introductory portion of our report, we have endeavoured to meet it mainly by the suppression of six thousand synonyms. Excepting where necessitated by our "Notes," and in cases where the discussion of life-histories renders an ample synonymy essential, we have reduced our references to two—the original description and one reference to a work in which either a sufficient synonymy will be found, or works containing it are referred to. Synonymies may be said to be virtually complete in Brady, 1884 F.C.,* down to 1880; in Millett, 1898, etc., F.M. (who generally omits Brady and everything before him, excepting the original author) down to 1903; and in Cushman 1910, etc., F.N.P., down to 1915. We have therefore made use principally of these authors, especially Dr. J. Augustine Cushman, whose synonymies are a

* For explanation of this system of condensed reference, see p. 236.

marvel of patient research and accurate record, to whom we beg in this place to record a warm tribute of admiration, and of thanks for the unrestricted use we have made of his work. We have also made free use of the full synonymies in our Kerimba monograph (1914, etc., F.K.A.).

As originally compiled we gave references to all the principal papers which have dealt with New Zealand and Antarctic Foraminifera, but these have been sacrificed under the self-denying ordinance. These works are set out in the part of our Introduction dealing with the Literature of the subject, and should be referred to by future students of the areas.

For the same reason we have suppressed "frequencies" and "Tables of Distribution"—probably the most expensive form of printing extant—and also the "Lists of Species" found in the outside gatherings from Tierra del Fuego, Kerguelen Island, Rio de Janeiro, and the "Discovery" material, described in Appendices A–D. In their place we have added after the "Lists of Stations" the letters R. d. J., K. I., T. d. F., and D., to indicate that the species was found in these samples of material.

Sub-Kingdom PROTOZOA.

Class RHIZOPODA.

Order FORAMINIFERA.

Family GROMIIDÆ.

GROMIA, Dujardin.

1. *Gromia oviformis*, Dujardin.

Gromia oviformis, Dujardin, 1835, Ann. Sci. Nat. Zool. [2], vol. iv, p. 343, pl. ix, figs. 1 2.

Stations 46, 53, (?) 54.

A single large individual at Stn. 46, free from incrustation, several more or less incrusted at Stn. 53, and two large but somewhat doubtful specimens at Stn. 54.

Family MILIOLIDAE.

Sub-Family NUBECULARIINAE.

NUBECULARIA, Defrance.

2.—*Nubecularia tibia*, Jones and Parker.

Nubecularia tibia, Jones and Parker, 1860, FCD, p. 455, pl. xx, figs. 48 51.
" " Heron-Allen and Earland, 1914, etc., FKA, 1915, p. 548.

Station 6.

A few attached individuals, one with a roughened surface and closely resembling d'Orbigny's figure of *Webbina rugosa* (d'Orb., 1839, FIC, p. 126, pl. 1, figs. 16–18; and 1846, FFV, p. 74, pl. xxi, figs. 11, 12). No free specimens of the more generally recorded type were observed.

[Arenaceous isomorph, *Reophax distans*, Brady, Hyaline isomorph, *Nodosaria*

inflexa, Rss.. Sessile individuals isomorphous with sessile specimens of *Reophax spiculifera*, Brady, referred to in our note on that species.]

3.—*Nubecularia tubulosa*, Heron-Allen and Earland.

Nubecularia tubulosa, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 548, pl. xl, figs. 1–5.

Stations 2, 6.

Occurs in profusion on shells, stones, and stems of Gorgonids. On many of the stones from Stn. 2 the surface is practically covered with a densely interwoven mass of these delicate little tubes. As a rule the branching tubes, intersect, the individuals preserving their identity, one tube passing over another, but in several instances what appears to be a true anastomosis of the tubules was observed.

[Arenaceous isomorph. *Sagenina frondescens*, Brady, and *S. divaricans*, Cushman.]

4. *Nubecularia lucifuga*, Defrance.

Nubecularia lucifuga, Defrance, 1825, Dict. Sci. Nat. (Strasburg, 1816-1830), vol. xxxv. p. 210; Atlas Zooph. pl. xliv. fig. 3.
.. .. Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 549.

Stations 2, 4, 6.

Only from the N.Z. area, where it occurs both adherent to stones and free. The specimens are not particularly robust.

[Arenaceous isomorph, *Placopsilina cenomana*, d'Orb. Hyaline isomorph, the young stage of *N. lucifuga* as figured by Sidebottom (S., 1904, etc., RFD) is *Truncatulina lobatula* (W. & J.); older specimens *T. variabilis*, Soldani type.]

5. *Nubecularia lucifuga*, var. *decorata*, Heron-Allen and Earland.

Nubecularia lucifuga var. *decorata*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 549, pl. xl, figs. 6, 7.

Station 2.

Fine and typical specimens occur on the stones from this Station.

6. *Nubecularia bradyi*, Millett.

Nubecularia inflata, Brady, 1884, FC. p. 135, pl. i, figs. 5–8.
.. *bradyi*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 550, pl. xl, figs. 8–10.

Station 6.

Two specimens, neither very typical, and which might perhaps be described as nubecularine miliolids. *N. bradyi* is a common form in tropical and subtropical Pacific gatherings, and it is interesting to record the form from N.Z. waters, from which it has also been recorded as not uncommon by Cushman (C. 1919, RFNZ, p. 636, pl. lxxv, fig. 6).

SUB-FAMILY MILIOLININAE.

BILOCULINA, d'Orbigny.

7. *Biloculina irregularis*, d'Orbigny.

Biloculina irregularis, d'Orbigny, 1839, FAM. p. 67, pl. viii, figs. 20, 21.
,, ,, Heron-Allen and Earland, 1916, FWS. p. 206.

Stations 2–4, 6, 31, 38, 45, 46, 48, 53, 54.

Attains its maximum frequency and development in the N.Z. area at Station 6, where a good range of specimens in all stages was obtained. In the Antarctic material the specimens are, as a rule, few in number, but large and well developed at several Stations, especially Stations 46 and 53.

8. *Biloculina sphaera*, d'Orbigny.

Biloculina sphæra, d'Orbigny, 1839, FAM. p. 66, pl. viii, figs. 13–16.
,, ,, Brady, 1884, FC. p. 141 (fig.), pl. ii, fig. 4*a*, *b*.

Stations 6, 26, 54.

Sparingly represented in the N.Z. area by a fairly good series of specimens, none attaining any considerable size. The Antarctic records show a few enormous specimens characterised by extremely labyrinthic apertures.

There is an increasing tendency to refer this species to the genus *Planispirina*, on account of the arrangement of the earlier chambers, but it is so essentially biloculine in external form that we prefer to retain the original nomenclature.

9. *Biloculina bulloides*, d'Orbigny.

Biloculina bulloides, d'Orbigny, 1826, TMC. p. 297, no. 1, pl. xvi, figs. 1–4, Modèle no. 90.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 551.

Stations 1–3, 5, 6, 9, 16, 19, 36, 53 55 (+ R. d. J.).

The specimens from the N.Z. area are rather small, the best and most typical from Station 6. It is nowhere common. An abnormal individual with an accessory chamber and tubular orifice over the aperture was found at Station 2. In the deep water between N.Z. and the Antarctic circle the specimens attain better growth, but they reach their maximum dimensions in S. Polar waters, notably at Station 48, where very large individuals were found. At Station 36 both typical specimens and specimens with projecting tubular apertures (*B. lucernula*, Schwager, S. 1866, FKN. p. 202, pl. iv, fig. 17) were observed.

10. *Biloculina ringens* (Lamarck).

Miliolites ringens, Lamarck, 1804, etc., AM. vol. v, p. 351, no. 1, vol. ix, pl. xvii, fig.
Lamarck, 1816, etc., ASV. vol. vii, p. 612; 1835, etc., vol. xi, p. 289, no. 1.
Biloculina ,, Heron-Allen and Earland, 1915, FKA. p. 550.

Stations 1, 6, 48.

A good many specimens at Station 6 (N.Z.) large and typical, otherwise represented by single specimens of the depressed form figured by Brady (Fig. 7) and named

after him, *B. bradyi*, by Schlumberger (S. 1891, BGF. p. 170, text figs. 15–19, pl. x, figs. 63–71). None of the specimens show the transverse ridges of shell-matter figured by Schlumberger, but not appearing in Brady's original figure, or Chapman's (C. 1914, FORS. p. 57, pl. 1, fig. 1; and C. 1909, SNZ. p. 314, pl. xiii, fig. 1).

11. *Biloculina comata*, Brady.

Biloculina comata, Brady, 1879, etc., RRC. 1881, p. 45; 1884 FC. p. 144, pl. iii, figs. 9*a*, *b*.

Stations 1, 4, 8, 10 12.

N.Z. area only. The species attains a comparatively large size, especially at Stations 10 and 11. The individuals differ from Brady's type, which may be regarded as a striate form of *B. ringens* and *B. bulloides*. The N.Z. specimens are closely allied to *B. lucernula*, Schwager, the produced tubular neck attaining noticeable dimensions at Stations 10, 11, 12. The only individual of Brady's type observed was at Station 1.

Judging by the recorded figures of Flint, Cushman and Schlumberger, *B. comata* is normally a striate variant of *B. ringens* and *B. bulloides;* the occurrence of similar surface ornament in another type, and prevalent in a particular area, is an interesting feature.

12. *Biloculina elongata*, d'Orbigny.

Biloculina elongata, d'Orbigny, 1826, TMC. p. 298, no. 4.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 552.

Stations 19, 26, 38, 46, 47 (+ K. I., R. d. J.).

Rare and confined to the Antarctic area. Large and quite typical specimens at Stations 46, 47 and 48.

13. *Biloculina depressa*, d'Orbigny.

Biloculina depressa, d'Orbigny, 1826, TMC. p. 298, no. 7, Modèle no. 91.
" " Cushman, 1910, etc., FNP. 1917, p. 74, pl. xxviii, figs. 1, 2.

Stations 1–6, 8, 10, 12, 17–20, 23, 27, 38 (+ K. I., D.).

The species reaches its maximum development, both as to numbers and size, at Station 6. At Stations 8 and 10 the individuals are furnished with a broad keel. In the Antarctic area it is much less frequent, and the specimens do not attain the development of the N.Z. forms.

14. *Biloculina depressa*, var. *murrhyna*, Schwager.

Biloculina murrhyna, Schwager, 1866, FKN. p. 203, pl. iv, figs. 15*a*, *b*.
" " Cushman, 1910, etc., FNP. 1917, p. 75, pl. xxviii, fig. 3; pl. xxix, fig. 1.

Stations 10–12, 17, 18, 19, 36 (+ T. d. F.).

Occurs in company with the type at several Stations, but at others the type is not represented. Maximum development at Station 11 (N.Z.), the Antarctic specimens are much weaker, and few in number.

15. *Biloculina depressa*, var. *serrata*, Bailey.

Biloculina serrata, Bailey, 1861, New Spp. Mier. Org. Para River, S. America. Boston Journ. Nat. Hist. vol. vii, p. 350, pl. viii, fig. E.
,, ,, Cushman, 1910, etc., FNP. 1917, p. 75, pl. xxix, fig. 2.

Station 12.

A single typical specimen. The depth at this Station (301 fms.) is much below the average depth of the records for this variety, which is nearly always confined to very deep water. Brady's authorship must lapse in favour of Bailey's, whose paper being concerned principally with Diatomaceae had been overlooked in this country. The paper is recorded under dates 1862 and 1863, but our copy bears the printed date July, 1861. Bailey's specimens were from the Gulf Stream (!) 150 fms.

SPIROLOCULINA, d'Orbigny.

16. *Spiroloculina nitida*, d'Orbigny.

Spiroloculina nitida, d'Orbigny, 1826, TMC. p. 298, no. 4.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 552.

Station 5.

A single moderately good example.

17. *Spiroloculina planulata* (Lamarck).

Miliolites planulata, Lamarck, 1804, AM. p. 352, no. 4; Lamarck, 1816, etc., ASV. vol. vii, p. 613, no. 4.
Spiroloculina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 555.

Station 6 (+ R. d. J.).

A single specimen.

18. *Spiroloculina excavata*, d'Orbigny.

Spiroloculina excavata, d'Orbigny, 1846, FFV. p. 271, pl. xvi, figs. 19–21.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 554.

Stations 5, 6.

Extremely rare.

19. *Spiroloculina affixa*, Terquem.

Spiroloculina affixa, Terquem, 1878, FIR. p. 55, pl. v, fig. 13.
,, *inaequilateralis*, Schlumberger, 1893, MGM, p. 202, pl. iv, figs. 84–86.

Stations, 2, 6.

This very distinctive type, although so rare in the European waters, and fossil deposits from which it was first described, is generally one of the most typical of the N.Z. fauna. In this material, however, it occurs at only two Stations, the specimens being, however, very well developed.

20. *Spiroloculina tenuis* (Czjzek).

Quinqueloculina tenuis, Czjzek, 1848, FWB. p. 149, pl. xiii, figs. 31–34.
Spiroloculina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 556.

Stations 6, 8, 10, 13, 16, 17, 23, 36 (+ T. d. F., R. d. J.).

As usual, it is practically impossible to separate this form from *Miliolina pygmaea*, but we are recording the spiroloculine forms separately for taxonomical reasons. In both the N.Z. and Antarctic areas it occurs in two distinct forms, porcellanous and sub-arenaceous. The two occur together at Station 6, where it is best represented, and at Stations 16 and 17. The porcellanous form occurs alone at Station 8 (N.Z.), and 13 (Ant.), where the individuals are exceptionally long. At the other Stations only the sub-arenaceous type occurs, the finest specimens being found at Stations 16 and 36.

21. *Spiroloculina arenaria*, Brady.

Spiroloculina arenaria, Brady, 1884, FC. p. 153, pl. viii, fig. 12.
" " de Amicis, 1893, CFP. p. 313, pl. iii, fig. 1.

Station 6.

A few very good examples.

MILIOLINA, Williamson

22. *Miliolina circularis* (Bornemann).

Triloculina circularis, Bornemann, 1855, FSH. p. 349, pl. xix, fig. 4.
Miliolina " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 557.

Stations 1–6, 26, 31, 37, 40, 46, 50, 55 (+ K. I., R. d. J., D.).

In the N.Z. area the specimens are, as a rule, very small, the best at Stations 1, 5 and 6. In the Antarctic the best series and the most abundant occur at the most southerly Station, 55, where it is well developed. At the other Stations it is extraordinarily variable in development and frequency, ranging from single small individuals to large (at Station 31) and one exceptionally large (fragmentary) at Station 37.

23. *Miliolina circularis*, var. *sublineata*, Brady.

Miliolina circularis, var. *sublineata*, Brady, 1884, FC. p. 169, pl. iv., fig. 7.
" " " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 558, pl. xli, figs. 9–11.

Station 27.

The specimens are few in number, and but feebly striate.

24. *Miliolina valvularis* (Reuss).

Triloculina valvularis, Reuss, 1851, FSUB. p. 85, pl. vii, fig. 56.
Miliolina " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 559.

Station 6.

Good specimens.

25. *Miliolina chrysostoma*, Chapman.

Miliolina chrysostoma, Chapman, 1909, SNZ. p. 322, pl. xiii, figs. 8–10; pl. xiv, figs. 1 and 4.

Stations 1, 5, 6.

A few specimens occur in the N.Z. area, which we think should be attributed to Chapman's form, resembling his figures 8 and 9. There are no instances exhibiting the extreme variation to which he refers.

26. *Miliolina labiosa* (d'Orbigny).

Triloculina labiosa, d'Orbigny, 1839, FC. p. 178, pl. x., figs. 12–14.
Miliolina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 559.

Stations 5, 6, 26, 53, 54.

Very rare, excepting at Station 26, where a good many typical examples occur.

27. *Miliolina bucculenta*, Brady.

Miliolina bucculenta, Brady, 1884, FC. p. 170, pl. cxiv, fig. 3 *a*, *b*.
,, ,, Heron-Allen and Earland, 1916, FWS. p. 208, pl. xxxix, figs. 4–6.

Stations 1, 5, 26, 38, 45, 48, 50.

Several small specimens in the N.Z. area; sparingly represented in the Antarctic; but good specimens occur at several Stations, notably at Stations 26 and 48. None of them, however, approach in size the enormous individuals found in the cold area of the Färoe Channel.

28. *Miliolina subrotunda* (Montagu).

Vermiculum subrotundum, Montagu, 1803, TB. pt. 2, p. 521.
Miliolina subrotunda, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 559.

Stations 3, 5, 6, 21.

Sparingly represented and not very typical, excepting at Station 5. The only Antarctic specimen was very small and feeble.

29. *Miliolina trigonula* (Lamarck).

Miliolites trigonula, Lamarck, 1804, etc., AM. 1804, vol. v, p. 351, no. 3.
Miliolina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 561.

Stations 2, 3, 5, 6, 9, 26, 31.

Reaches its best development in the N.Z. area at Station 6, where both the long and the short types attain fine development. The short type alone occurs at Stations 3 and 5, and the species is represented in the Antarctic by the short type only.

30. *Miliolina insignis*, Brady.

Miliolina insignis, Brady, 1879, etc., RRC. 1881, p. 45, 1884, FC. p. 165, pl. iv, figs. 8–10.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 562.

Station 6.

Specimens large and well-developed, but feebly sulcate.

31. *Miliolina tricarinata* (d'Orbigny).

Triloculina tricarinata, d'Orbigny, 1826, TMC. p. 299, no. 7, Modèle no. 94.
Miliolina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 562.

Stations 3, 5, 6, 16, 18, 19, 27, 31, 35, 38, 48, 50, 53, 54, 55.

Occurs in both the long "hazel-nut" type and the short robust form, the best at N.Z., Station 6, where the short form attains fine dimensions. The long form occurs only at Station 5 in the N.Z. area, but occurs to the exclusion of the short form in the deep-water Stations, between N.Z. and the Antarctic Continent. The short form reappears at Station 31 and occurs exclusively from there to the most southern latitudes, attaining better development as one approaches the shallower Stations of the Antarctic coast, the best individuals being obtained at Stations 38, 48, 54, and 55.

32. *Miliolina bosciana* (d'Orbigny).

Quinqueloculina bosciana, d'Orbigny, 1839, FC. 191, pl. xi, figs. 22–24.
Miliolina bosciana, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 566.

Stations 2, 3, 5, 6, 48 (+ KI).

Represented in the N.Z. area by single specimens only, except at Station 6, and all small. In the Antarctic by a single small specimen at Station 48.

33. *Miliolina oblonga* (Montagu).

Vermiculum oblongum, Montagu, 1803, TB. p. 522, pl. xiv, fig. 9.
Miliolina oblonga, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 566.

Stations 1–3, 5, 6, 15, 31, 36, 38 (+ R. d. J.).

Occurs in both the originally described and figured square-cornered form, and in the rounded type, figured by Brady. In the N.Z. area the square form predominates, the best being at Stations 1 and 5. At Station 3 the round form only occurs; at Station 6, both types together. Rare in the Antarctic, the round form at Stations 15 and 31; both types at Station 36. It is noticeable that the round type is always more thin-shelled and feebler than the angular, but none of the fragile type noted by us from West Scotland (H-A & E, 1916, FWS, p. 210) was seen in the material.

34. *Miliolina oblonga*, var. *arenacea*, Chapman.

Miliolina oblonga, var. *arenacea*, Chapman, 1914, FORS. p. 59, pl. i, fig. 7.
,, *alveoliniformis*, Fauré-Fremiet, 1913, etc., FMAF. 1914, p. 4, pl. O, fig. 5.

Stations 26, 27, 29, 32, 33, 41 45, 48, 50, 51, 52 (+ K. I., D.).

This is the most typical Miliolid of the Antarctic area, and presents a considerable range of form. The rounded type predominates, and represents the variety at most of the Stations, but the angular form occurs in its company at Stations 27, 43, 44, and 52. The test is very fragile and delicate; and the calcareous constituent, if present at all, must be very limited in quantity. The colour varies considerably. In the deeper water the specimens are a very pale

grey, almost white, but as the Polar Continent is approached the colour darkens owing to the increasing quantity of dark mineral constituent. The pale colour was at first thought to be due to the presence of diatomaceous material, but the examination of crushed specimens in balsam under a high power reveals an entire absence of such material, the test being constructed entirely of most minute mineral particles.

Fauré-Fremiet (*ut supra*) figures a form under the name of *M. alveoliniformis*, Brady, which certainly has no resemblance to Brady's type, but may be related to Chapman's, from which it differs in its cribrate aperture on a produced neck, its comparatively coarsely agglutinate test, and the arrangement of the chambers, which are on the *M. bosciana* or transverse plan, instead of the straight *M. oblonga* arrangement. The text-figure and description in his 1913 Paper (*ut supra* p. 262, fig. 4), however, shows a much less coarsely agglutinate shell, and the description brings the species into close agreement with our specimens, except that we have not observed any specimens with cribrate apertures.

35. *Miliolina gracilis* (d'Orbigny).

Triloculina gracilis, d'Orbigny, 1839, FC. p. 181, pl. xi. figs. 10–12.
Miliolina gracilis, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 567.

Station 6.

A single specimen, resembling d'Orbigny's original figure.

36. *Miliolina pygmaea* (Reuss).

Quinqueloculina pygmaea, Reuss, 1849–50, FOT. p. 384, pl. v (l.), fig. 3.
Miliolina pygmaea, Heron-Allen & Earland, 1914, etc., FKA. 1915, p. 567.

Stations 5, 8, 10, 11, 16, 17, 22, 36 (+ R. d. J.).

Frequent at a few Stations, rare at the others. The round milioline type predominates, but at Stations 10, 11 and 17 a compressed form occurs in its company in about equal proportions. The specimens at Station 17, of both types, are abnormally long and narrow.

37. *Miliolina seminulum* (Linné).

Serpula seminulum, Linné, 1767, SN. (ed. xii.) p. 1624, no. 791; Linné, 1788, SN. (ed. xiii.), p. 3739, no. 2.
Miliolina seminulum, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 569, pl. xlii. fig. 31.

Stations 2, 3, 5, 6, 17, 26, 30–32, 48 (+ K. I., R. d. J.).

Never very abundant. In the N.Z. area the bulk of the specimens are of the *M. vulgaris* (d'Orb.) type, but, in the Antarctic, d'Orbigny's type occurs only at Station 31, in company with typical *M. seminulum*. The best N.Z. area is Station 5, the best Antarctic Station 48, the only Station where it occurs with any frequency.

38. *Miliolina candeiana* (d'Orbigny).

Quinqueloculina candeiana, d'Orbigny, 1839, FC. p. 199, pl. xii, figs. 24–26.
Miliolina candeiana, Heron-Allen and Earland, 1914, etc. FKA. 1915, p. 570.

Stations 1. 4. 5.

Three minute individuals referable to this obscure form from Station 4. Better represented at Station 5. A single good specimen at Station 1.

39. *Miliolina venusta* (Karrer).

Quinqueloculina venusta, Karrer, 1869, MFKB. p. 147, pl. ii, fig. 6.
Miliolina venusta, Cushman, 1910, etc. FNP. 1917, p. 45, pl. xi, fig. 1.

Stations 2, 17, 18, 19, 27, 36 (+ T. d. F., R. d. J., D.).

Represented in the N.Z. area by doubtful specimens at Station 2. As might be expected, this deep-water form occurs in greatest numbers and development at the Stations to the S. of N.Z. Excellent examples at Stations 18, 19 and 36. At Station 27 (178 fms.) it is represented by a single poorly developed individual.

40. *Miliolina auberiana* (d'Orbigny).

Quinqueloculina auberiana, d'Orbigny, 1839, FC. p. 193, pl. xii, figs. 1–3.
Miliolina auberiana, Heron-Allen and Earland 1914, etc., FKA. 1915, p. 571.

Stations 1–6, 38, 47 (+ R. d. J.).

Poorly represented. The best specimens from Station 1. At Station 6 it occurs in a variety with a double keel on the marginal edge of the chambers approaching the form figured by Silvestri (S, 1896, etc., FPS, 1896, p. 44, pl. i, fig. 21, pl. ii, fig. 1) under the name of *M. angulata*, a specific name already preoccupied by Terquem. The Antarctic specimens are very few in number, and of minute size.

41. *Miliolina calcarata*, sp. nov. Pl. I, figs. 4–6.

Stations 48, 50.

Miliolinae with spinous decoration are extremely rare. The earlier recorded example is d'Orbigny's *Triloculina echinata* (d'Orb., 1826, TMC, p. 300, No. 14), the whole surface of which is covered with minute spines. Costa's *Quinqueloculina denticulata* (C. 1853, etc., PRN, 1856, p. 325, pl. xxv, fig. 9 (error for 6)) has a spinous ornamentation round the outer edge, due to extension of the keel. Brady, Parker and Jones figured a form akin to *M. tricarinata*, with a few large blunt spines on the outer keel, under the name *M. excisa* (B. P. & J., 1888, AB. p. 215, pl. xl., fig. 33). Millett, in 1898, recorded *M. cristata* from the Malay Archipelago, a minute form between *M. cuvieriana* and *M. venusta* (M. 1898, etc., FM, 1898, p. 506, pl. xii, figs. 3, *a–c*). This has only a few blunt spines confined to the keel of the last chamber. In 1904 Sidebottom figured *M. seminulum*, var. *cornuta*, from Delos, with similar ornamentation (S, 1904, etc., RFD, 1904, p. 11, fig. 3, and pl. iii, figs. 11, 12). We ourselves have figured

and described *M. tricarinata*, var. *serrata*, from Kerimba (H.-A. & E., 1914, etc., FKA, 1915, p. 563, pl. xli, figs. 23–25), distinguished by serrated margins to the chambers.

The two specimens which we record from the Antarctic material differ considerably from any of the foregoing types, the main distinction being the continuance of the spines on the penultimate and antepenultimate chambers, thus giving a distinctive appearance to the median line of the test, as compared with Millett's figure, which, in other respects, they closely resemble. Their zoological position is probably nearest to *M. auberiana*, which does not occur at these Stations.

Test, small, quinqueloculine, chambers angular in section, furnished down the outer edge with a series of short, blunt spines, directed towards the aboral end of the chambers. Earlier chambers appearing transversely across the middle of the shell. Aperture small, directed laterally, and furnished with a prominent tooth.

Size :—Length, ·40 mm. ; Breadth, excluding projections, ·27 mm. ; Maximum breadth, ·30 mm.

42. *Miliolina cuvieriana* (d'Orbigny).

Quinqueloculina curieriana, d'Orbigny, 1839, FC. p. 190, pl. xi, figs. 19–21.
Miliolina curieriana, Heron-Allen and Earland, 1914, etc. FKA. 1915, p. 571, pl. xlii, figs. 33–36.

Station 10.

A single, rather feeble specimen.

43. *Miliolina agglutinans* (d'Orbigny).

Quinqueloculina agglutinans, d'Orbigny, 1839, FC. p. 195, pl. xii, figs. 11–13.
Miliolina agglutinans, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 575.

Stations 3, 6 (+ R. d. J.).

Confined entirely to the N.Z. area. At Station 6 the specimens are large and coarsely agglutinate. The only other record, at Station 3, consists of a single finely agglutinate small individual.

44. *Miliolina fusca* (Brady).

Quinqueloculina fusca, Brady, 1870, FTR. p. 286, pl. xi, fig. 2.
Miliolina fusca, Heron-Allen and Earland, 1914, etc. FKA. 1915, p. 576.

Station 6.

A good series of specimens.

45. *Miliolina contorta* (d'Orbigny).

Quinqueloculina contorta, d'Orbigny, 1846, FFV. p. 298, pl. xx, figs. 4–6.
Miliolina contorta, Heron-Allen and Earland, 1914, etc. FKA. 1915, p. 576.

Stations 6, 48, 50.

The best specimens occur at the only N.Z. Station, No. 6, where there is a

good series, including both the rounded and angular edged types. Otherwise very rare, the best Antarctic specimen (angular) being at Station 50.

46. *Miliolina sclerotica* (Karrer).

Quinqueloculina sclerotica, Karrer, 1868, MFKB. p. 152, pl. iii, fig. 5.
Miliolina sclerotica, Heron-Allen and Earland, 1914, etc. FKA. 1915, p. 577, pl. xliv, figs. 1–4.

Stations 2, 6.

Very rare. The most typical specimens at Station 2. At Station 6 practically inseparable from *M. contorta*.

47. *Miliolina ferussacii* (d'Orbigny).

Quinqueloculina ferussacii, d'Orbigny, 1826, TMC. p. 301, no. 18, Modèle no. 32.
Miliolina ferussacii, Heron-Allen and Earland, 1914, etc. FKA. 1915, p. 578.

Stations 1 6, 20 (+ R. d. J.).

Occurs at all the inshore N.Z. Stations, and presents a wide range of variation. The best specimens at Stations 1 and 6. At the latter a small, neatly constructed type predominates. Represented in the Antarctic by a single individual at Station 20.

48. *Miliolina polygona* (d'Orbigny).

Quinqueloculina polygona, d'Orbigny, 1839, FC. p. 198, pl. xii. figs. 21–23.
Miliolina polygona, Goës, 1894, ASF. p. 111, pl. xx, fig. 854 *a-g*; pl. xxi, figs. 859 *a-c*.
" " Chapman, 1909, SNZ. p. 321, pl. xiii, fig. 6.

Station 6.

A single typical specimen.

49. *Miliolina linnaeana* (d'Orbigny).

Triloculina linneiana, d'Orbigny, 1839, FC. p. 172, pl. ix, figs. 11–13.
Miliolina linnaeana, Heron-Allen and Earland, 1914, etc. FKA. 1915, p. 579.

Stations. 2, 6.

The specimens are feeble. At Station 6 they are compressed and almost spiroloculine.

50. *Miliolina brongniartii* (d'Orbigny).

Triloculina brongniartii, d'Orbigny, 1826, TMC. p. 300, no. 23.
Miliolina brongniartii, Heron-Allen and Earland, 1914, etc. FKA. 1915, p. 580.

Station 1.

A single specimen.

Sub-genus, SIGMOILINA, Schlumberger.

51. *Sigmoilina orata*, Sidebottom.

Sigmoilina orata, Sidebottom, 1904, etc., RFD. 1904, p. 6, pl. ii, figs. 12, 13, text-fig. 1.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 584, pl. xlv, figs. 16–18.

Stations 1–6, 18–20, 36.

Occurs in both areas, the best specimens off N.Z. At Station 6 specimens infiltrated with glauconite occur. The Antarctic specimens are, as rule, smaller and less typical.

52. *Sigmoilina edwardsi*, Schlumberger.

Planispirina (*Sigmoilina*) *edwardsi*, Schlumberger, 1887, P. p. 483 (113 in the reprint), text-fig. 8, pl. vii, figs. 15–18.
„ „ „ Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 584, pl. xlv, figs. 19–21.

Station 6.

A single typical specimen.

53. *Sigmoilina umbonata*, sp. nov. Plate I, Figs. 7, 8.

Stations 27, 31, 45, 47, 48, 53, 55.

Test, free, minute, circular in outline with a raised central boss on each face. Edge rounded. Aperture a minute slit. Surface smooth and polished, especially on the bosses.

Dimensions:—Breadth ·20–·30 mm.; thickness, ·20 mm.

This obscure little form, which occurs in some numbers at several Antarctic Stations, presents features analogous to *S. sigmoidea*, but differs in its circular outline and the raised central bosses. The possibility of its representing the initial stage of a large Miliolid must not be overlooked, but no specimens representing a transition between this and any Miliolid occurring at the same Station have been observed.

54. *Sigmoilina sigmoidea* (Brady).

Planispirina sigmoidea, Brady, 1884, FC. p. 197, pl. ii, figs. 1–3, and p. 194, fig. 5 *c*.
„ „ Heron-Allen and Earland, 1916, FWS. p. 216, pl. xxxix, figs. 32–34.

Stations 2, 3, 6, 16, 38 (+T. d. F.).

One long, narrow specimen at Station 3, and a few, more typical, at Station 16. At Stations 2, 3, 6, and 38, a few specimens which, though referable to this species, are characterized by their minute size, and the breadth of shell, which is almost equal to the length, giving a nearly circular outline.

55. *Sigmoilina celata* (Costa).

Spiroloculina celata, Costa, 1855, FFMV. p. 126, pl. i, fig. 14; 1853, etc., PRN. 1856, pl. xxvi, fig. 5.
Planispirina celata, Heron-Allen and Earland, 1916, FWS. p. 216.

Stations 5–8, 10–12 (+R. d. J.).

Confined to the N.Z. area and best represented at Station 6. Both the broad original type of Costa, figured by Schlumberger (S., 1887, P., p. 111, pl. vii, figs. 12–14), and the long, narrow type figured by Brady and named *Sigmoilina schlumbergeri* by Silvestri (S., 1904, TB. p. 267) occur. At Station 10 the original type occurs in very broad, outspreading form.

Sub-Family HAUERININAE.

ARTICULINA, d'Orbigny.

56. *Articulina funalis*, Brady.

Articulina funalis, Brady, 1884, FC. p. 185, pl. xiii, figs. 6–11.
" " ; Heron-Allen and Earland, 1914, etc., 1915, FKA. p. 587.

Stations 2, 26, 27, 31, 38, 45, 48, 53–55 (+K. I.).

Confined to the Antarctic area, excepting for two typical specimens from the N.Z. area. At a few of the Antarctic Stations near the coastline it is remarkably abundant and attains a great length. It is also extraordinarily variable in the breadth of the oral extremity. At Station 38 individuals not only attain a great size compared with the normal, but also exhibit a breadth and strength of growth exceeding all other records. They may be compared to Brady's Fig. 2, pl. xiii, attributed by him to *A. conico-articulata*. These individuals are marked at fairly regular intervals with deep constrictions, suggesting septal divisions, and an examination of the interior of the shell shows that there is an inner thickening, constricting the diameter of the tube, at these points, though the apertures remain practically constant. The bulbous initial extremity exhibits no sign of the milioline commencement predicated by Brady in his description of the species; it is merely an inflated cavity, but it is always set unsymmetrically, the maximum turgidity extending sometimes on the side of curvature, and sometimes on the opposite side.

The relationship between this form and *Articulina* is not very apparent, except through the intermediary of such specimens of *A. conico-articulata* as we figured from Kerimba (H.-A. & E., 1914, etc., FKA. 1915, p. 586, pl. xlv, figs. 32, 33) and there is something to be said for Rhumbler's action in transferring the species to a new genus, *Tubinella*, allied to *Nubecularia*. We have modified our views expressed upon this matter, as a result of the examination of this vast collection of specimens of *A. funalis*.

57. *Articulina funalis*, var. *inornata*, Brady.

Articulina funalis var. *inornata*, Brady, 1884, FC. p. 186, pl. xiii, figs 3–5.
" " " " Millett, 1898, etc., FM. 1898, p. 513, pl. xxi, fig. 11.
Tubinella inornata Rhumbler, 1906, FLC. p. 27, pl. ii, fig. 4.

Station 3.

A few typical specimens.

OPHTHALMIDIUM, Kübler.

58. *Ophthalmidium margaritiferum*, sp. nov. Pl. I, Figs. 9–12.

Stations 3, 6.

Test, porcellanous, roughly discoidal, commencing with an inflated primordial chamber, followed by one or two convolutions rather rapidly increasing in width, unseptate. The shell then becomes septate, the constrictions being, however, of

an elementary character. Successive chambers, two or three in number, occupying more than half, and up to two-thirds of a convolution. Broadest at mid-chamber length and narrowing towards the aperture, which is furnished with a thickened lip, and a rudimentary tooth. In the megalospheric form the primordial chamber projects as a clear button in the middle of the flattened disc. The microspheric form has not been found.

The nearest ally of the species would be *O. tumidulum*, Brady, with which our form agrees in the rounded shape of the peripheral margin, but differs in the greater length of the latter chambers, which, by occupying more than half of the circumference, destroy the spiroloculine plan of Brady's species. It may be regarded as a connecting link between *Planispirina exigua*, Brady, and *O. tumidulum*, Brady. The presence of the oral tooth indicates its spiroloculine affinity. Size: —·30 ·40 mm. in diameter; ·05 mm. in thickness.

Rare and small at Station 3, more numerous and well-developed at Station 6.

(Note.—Rhumbler (R., 1909, etc., FPE. 1909, pl. ix, fig. 18) figures a small *Ophthalmidium*, without any specific name being given in the text, which closely resembles our form.)

PLANISPIRINA, Seguenza.

59. *Planispirina cliarensis*, Heron-Allen & Earland.

Planispirina cliarensis, Heron-Allen and Earland, 1913, CI. p. 35, pl. ii, figs. 7, 8.

Station 6.

Two specimens presenting the characteristic small aperture of the type, but in one case more convex than the type, and so approaching *P. auriculata*, Egger.

Sub-Family FISCHERININAE.

FISCHERINA, Terquem.

60. *Fischerina helix*, Heron-Allen and Earland.

Fischerina helix, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 591, pl. xlvi, figs. 10–11.

Stations 4, 6.

A few specimens, smaller than the original type, but exhibiting all the characteristic features.

Sub-Family PENEROPLIDINAE.

CORNUSPIRA, Schultze.

61. *Cornuspira foliacea* (Philippi).

Orbis foliaceus, Philippi, 1844, EMS. p. 147, pl. xxiv, fig. 25 (error for 26).
Cornuspira foliacea, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 592.

Stations 6, 26, 53 (+K. I.).

Occurs in two forms, the original figure of Philippi, in which the final whorl is not very much broader than its predecessors, and in the thin compressed form

illustrated by Brady (pl. xi. fig. 5) in which there is an immense increase in the width of the final convolution. Represented in the N.Z. area by the wide-tubed type attaining comparatively enormous dimensions: one broken shell probably exceeded a quarter of an inch in diameter. Only the narrow-tubed type occurs in the Antarctic material, but at Station 26 this also reaches a very large size.

[Arenaceous isomorph, *Ammodiscus tenuis*, Brady, Hyaline isomorph, *Spirillina vivipara*, Ehbg., evolute forms.]

62. *Cornuspira selseyensis*, Heron-Allen and Earland.

Cornuspira (?) Earland, 1905, FBS. p. 199, pl. xiii. figs. 2–4.
" *selseyensis*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 592.

Stations 4, 6, 26, 31, 38, 45, 46, 48, 53–55.

Occurs in both areas, but much more frequently in the Antarctic. It is entirely missing at all the deep-water Stations. The specimens even from the most southerly latitudes differ in no respect from the original English types. Station 31 (268 fms.) is perhaps distinctive in the exhibition of tests more stoutly constructed than is usually the case.

63. *Cornuspira involvens* (Reuss).

Operculina involvens, Reuss, 1849 50, FOT. p. 370, pl. i (xlvi), fig. 20 (not 30).
Cornuspira " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 593.

Stations 3, 5, 6, 10, 26, 31, 38, 46, 48, 50, 53–55 (+K. I., D.).

Occurs in both megalospheric and microspheric forms, both together at Stations 38 and 48, the microspheric alone at Stations 3, 5, 6 and 31, the megalospheric alone at Stations 10, 26, 46, 50, 53, 54 and 55, at all of which Stations specimens attain fine dimensions, the largest at Station 26. For its remarkable occurrence at Station 10, see our note on *Hyperammina ramosa* (No. 91).

[Arenaceous isomorph, *Ammodiscus incertus* (d'Orb.), Hyaline isomorph, *Spirillina vivipara*, Ehbg., closely coiled forms.]

64. *Cornuspira diffusa*, Heron-Allen & Earland.

Cornuspira diffusa, Heron-Allen and Earland, 1912, etc., NSG. 1913, No. 3, pp. 272–276, pl. xii.; 1913, CI. p. 37; 1916, FWS. p. 217.

Station 6.

This interesting form is quite one of the most typical Foraminifera at this Station, where it occurs in abundance and is characterized by the wildest out-growths. No individuals were found exhibiting any trace of the spiral centre observed in our type specimens; some of them, indeed, show a closed extremity to the initial portion, whilst in others the initial extremity is narrowed down to a cup-like opening suggestive of a sessile habit. It would thus appear to link *Cornuspira* with *Nubecularia*.

65. *Cornuspira striolata*, Brady.

Cornuspira striolata, Brady, 1882, FKE. p. 713; 1884, FC. p. 202, pl. cxiii. figs. 18, 19.
,, ,, Heron-Allen and Earland, 1912, etc., NSG. 1913, No. 3, p. 274, fig. 36.

Station 47.

No specimens were observed in any of the material submitted to us for examination, but two very large and perfect specimens preserved in spirit on board ship were submitted to us for identification from official Stations 316 and 339, the latter being our Station 47. The specimen from the former Station measured 19 by 21 mm., and therefore approximates in size to the enormous specimens observed originally by Murray, and subsequently by Earland in the cold area of the Färoe Channel. The specimen from Station 339 (H.-A. & E., Station 47) is much smaller, being only 8 mm. maximum diameter.

Family ASTRORHIZIDAE.

Sub-Family ASTRORHIZINAE.

ASTRORHIZA, Sandahl.

66. *Astrorhiza limicola*, Sandahl.

Astrorhiza limicola, Sandahl, 1857, Öfvers. K. Vet. ak. Forh. vol. xiv, p. 299, pl. iii. figs. 5 and 6.
,, ,, Brady, 1884, FC. p. 231, pl. xix. figs. 1–4

Stations 26, 50.

The records depend upon two specimens from Station 50, and more doubtful individuals from Stations 26 and 55.

67. *Astrorhiza arenaria*, Norman.

Astrorhiza arenaria (Carpenter MS.), Norman, 1876, Proc. Roy. Soc., vol. xxv, p. 213.
,, ,, Brady, 1884, FC. p. 232, pl. xix, figs. 5–10.

Stations 6, 40.

A few individuals from Station 6, characterized by the very large size of the sand-grains, and the loose manner in which they are agglutinated. In one specimen the radiating pseudopodia have been preserved with sand-grains attached as though in the act of gathering material for addition to its test. The Antarctic record rests on a somewhat doubtful specimen.

IRIDIA, Heron-Allen and Earland.

68. *Iridia diaphana*, Heron-Allen and Earland.

Thurammina papillata (?) Earland, 1905, FBS. p. 201, pl. xi, figs. 6, 7; pl. xiv, figs. 1–3.
Webbina hemispherica, Heron-Allen and Earland, 1908, etc., SB. 1909, p. 325, pl. xv, fig. 14.
Iridia diaphana, Heron-Allen and Earland, 1914, etc., FKA. 1914, p. 371, pl. xxxvi. 1915, p. 607.
,, ,, Heron-Allen and Earland, 1916, FSC. p. 37.
,, ,, (*Placopsilina intermedia*, Halkyard), Halkyard, 1919, BMB. p. 26, pl. i. fig. 8; (*Placopsilina aggregata*, Halkyard) Ibid., p. 27, pl. viii. figs. 3, 4.

Stations 3, 4, 6, 26, 38, 47, 48, 50, 53 (+ D.).

To this organism we attach great biological importance, having regard to the fact that it is probably a representative of the earliest and most elementary marine Rhizopods. Our views and deductions, so far as they have gone already, may be found in the works referred to in the above synonymy. We have suggested that it is of world-wide distribution, and its reappearance in these southern latitudes adds force to our observations.

It occurs in both areas, the best N.Z., at Station 6, where many large and typical examples occur. Also abundant specimens of a small hemispherical chitinous form, very closely resembling the early Selsey examples, originally referred by us to *Webbina hemispherica*, but with a pronounced aperture at the side near the attached edge. These individuals may probably represent a local form of the initial stage. In the Antarctic the best individuals occurred at Stations 47, 48, and 53, smaller than the N.Z. specimens, excepting at Station 47, but quite typical, and exhibiting the chitinous floor admirably. At Station 26 a single example with a test constructed of very fine mud.

VANHOEFFENELLA, Rhumbler.

69. *Vanhoeffenella gaussii*, Rhumbler. Pl. I, Figs. 14, 15.

Vanhoeffenella gaussii, Rhumbler, 1905, MP. p. 105, fig. 9.
" " Rhumbler, 1909, FPE. p. 216, fig. 57.
" " Heron-Allen and Earland, Proc. Zool. Soc. Lond., 1915, p. 296.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 608.
" " Heron-Allen and Earland, 1916, FSC. p. 37.

In a small jar containing muddy sand, without any label or identifiable particulars beyond the unquestionable fact that the material was from the Antarctic, and, judging by the size of the sand-grains, from comparatively shallow water, were found two perfect individuals of this species. This "find" proved of exceptional interest to us because a careful examination of the specimens has removed any lingering doubts which we might have had as to the identity of *Vanhoeffenella* with *Iridia*. They are essentially distinct. Under a high magnification the angular framework supporting the characteristic chitinous membrane which forms the two faces of *Vanhoeffenella* is seen to be a hollow tube with labyrinthic interior, constructed of minute Diatom and mineral débris. At each angular point of the frame there is an external opening from which the dried protoplasm is seen in both specimens to be exuded. The large mass of the protoplasmic body is, however, as in Rhumbler's figure, collected into a rounded, or oval, nodule in the centre of the cavity between the chitinous sides.

In the absence of details as to locality this jar of material was not systematically examined.

PELOSINA, Brady.

70. *Pelosina variabilis*, Brady.

Pelosina variabilis, Brady, 1879, etc., RRC. 1879, p. 30, pl. iii, figs. 1–3.
,, ,, Heron-Allen and Earland, 1916, FWS. p. 218.

Stations 2, 55.

A few doubtful, small specimens at Station 2. In the Antarctic a very good example at Station 55.

71. *Pelosina rotundata*, Brady.

Pelosina rotundata, Brady, 1879, etc., RRC. 1879, p. 31, pl. iii, figs. 4, 5; 1884, FC. p. 236, pl. xxv, figs. 18–20.
,, ,, Millett, 1898, etc., FM. 1899, p. 249, pl. iv, fig. 1.

Stations 46, 50, 55.

Confined to the Antarctic. A small individual at Station 46, presenting a tubular chitinous neck; large and more typical at Stations 53 and 55, but oval in shape and without the produced neck, resembling in shape and surface-construction the figures of *P. arctica*, Awerinzew (Sibirischen Eismeer, 1911, Mém. Ac. Imp. Sci. St. Petersburg. Ser. 8, vol. xxix, No. 3, p. 7, pl. 0, figs. 7, 8.)

72. *Pelosina cylindrica*, Brady.

Pelosina cylindrica, Brady, 1884, FC. p. 236, pl. xxvi, figs. 1–6.
,, ,, Cushman, 1910, etc., FNP. 1910, p. 46, figs. 50, 51.

Stations 38, 48 (+ D.).

Confined to the Antarctic. One good specimen at Station 38, and a very large one at Station 48.

STORTHOSPHAERA, Schulze.

73. *Storthosphaera albida*, Schulze.

Storthosphaera albida, Schulze, 1874, R. p. 113, pl. ii, fig. 9 *a–d*.
,, ,, Brady, 1884, FC. p. 241, pl. xxv, figs. 15–17.

Station 6.

The species is represented by a single specimen. In this, the external corrugations characteristic of the genus are but weakly developed, and the general appearance of the test is strongly suggestive of an affinity with *Crithionina rugosa*, Goës (G. 1896, DOA. p. 24, pl. ii, figs. 3, 4).

Although *S. albida*, as seen in Schulze's figures and in typical specimens from the deep areas of the North Sea, is a very distinctive form, it differs but very slightly from the later established genus *Crithionina*. The principal distinctions are the comparatively large size of the internal cavity in *Storthosphaera*, and the thinness of the investing wall, coupled with the corrugated exterior, but Pearcey's species, *S. depressa* (P., 1900, RCA. p. 37, pl. 1, fig. 1, *a–c*), appears to us to form a connecting link between the two genera. Owing to the rarity or absence of the external corrugations, the rougher construction of the test, and the decrease

in the size of the internal cavity, it represents a form midway between *S. albida* and *Crithionina granum*, Goës, and it becomes a question whether Goës's generic name should not be abandoned in favour of Schulze's earlier creation.

DENDRONINA, nov. gen.

Test sessile or free, unseptate, built of fine mud, sand-grains and sponge-spicules, agglutinated with varying proportions of cement and furnished with an internal or external chitinous membrane.

Initial portion of sessile specimens either a depressed amoebiform basal pad, with ramifying passages converging to a central cavity, or a more or less turgid basal chamber, with simple or labyrinthic cavity. From the basal pad or chamber rise one or more tubular outgrowths, simple or branching, diminishing in diameter towards the terminal apertures.

In free-growing specimens the basal portion is bulbous with entire or labyrinthic cavity, often of large size, from which arise one or more tubular outgrowths developing as in the sessile form.

Very fragile in the dry condition, but probably more or less flexible in the living state.

The "Terra Nova" material furnishes representatives of this new genus of Astrorhizidae, which forms a connecting link between *Masonella*, Brady, and *Dendrophrya*, Strethill Wright. Its affinities with the former are shown by the labyrinthic structure of the basal pad, and with the latter by its unseptate tubular extensions and the occurrence of specimens showing only rudimentary labyrinthic structure.

Two distinct species occur in the New Zealand area, which are replaced in the Antarctic by two varieties of simpler structure, and less striking development. We have fragments of what appears to be a similar organism from Mauritius, and the genus may prove eventually to have a wide distribution.

74. *Dendronina arborescens*, sp. nov. Pl. II, figs. 10–12, 14–18.

Stations 2, 3, 4, 6.

Organism usually sessile, but sometimes free; unseptate; arborescent; commencing in the sessile form with a basal pad of irregular shape, attached to stones, sponges and other bodies, and, in the free form, with a more or less bulbous thin-walled chamber of large dimensions. From the basal pad or bulb arise one or more hollow unseptate and thick-walled trunks of varying lengths and proportions, constructed of fine grey mud, sand, and sponge-spicules with a considerable proportion of cement. The sponge-spicules are regularly laid with their long axes parallel to the line of growth of the trunk, which furcates at irregular intervals into branches of diminishing size. Surface-walls of basal pad, trunk and branches smooth, either matt or exhibiting a glaze due to the presence of a

thin external chitinous membrane. Apertures terminal, simple or furnished with a radiating corona of spicules. Very brittle when dry, but probably more or less flexible in the living state. No perfect specimens were received.

The basal pad (Fig. 12A) is normally composed of fine grey mud and acicular spicules, both entire and broken. The spicules are arranged with some regularity, converging towards the raised centre of the pad from which the main trunk arises. When attached to a plane surface the basal pad is amoeboid in outline, but otherwise it conforms to the contour of the host. It is easily detached, and when mounted in balsam (Fig. 17) exhibits a number of branching tubes, originating in one or more central cavities and radiating, as in *Masonella*, towards the edges of the pad, but having no visible external apertures.

These basal cavities are sometimes, but not always, visible when the under surface of a detached pad is examined. It seems probable that the specimens thus exhibiting the basal cavity have become broken in detachment, leaving the floor of the basal pad attached to the host.

From the central cavities of the pad originates the hollow trunk (Fig. 12B) which rises from the pad and varies greatly in appearance. More than one trunk may rise from the same pad (Fig. 12C). Normally the trunk takes the form of a thick-walled tube, gradually diminishing in diameter and furcating at irregular intervals, each branch again dividing into smaller branchlets (Fig. 12E), but remaining unseptate throughout (Fig. 18).

The trunk may, however, terminate while still unbranched (Fig. 12C), ending with a terminal crown of radiating sponge-spicules which no doubt serve as supports for pseudopodial extensions, as in *Marsipella cylindrica*, *Haliphysema tumanowiczii*, and other species. A similar terminal appendage may occur on a side branch after furcation of the main trunk (Fig. 12D).

No complete branching specimens have been found presenting an unbroken terminal extremity, and the nature of the orifice at the end of the small branchlets remains to some extent problematical. They may end in a simple constricted aperture, but it is more probable that they terminate in a more or less loosely agglomerated and radiating crown of projecting spicules, as does *Marsipella cylindrica*, which is of about the same diameter. There can be no doubt that the extraordinary terminal fragment (Fig. 12F) reproduced in our plate belonged to our species, but the proportion of spicules to cement is higher than was observed in any other fragment, and it must be regarded as abnormal.

A certain number of basal portions have been found which exhibit little or no evidence of a sessile condition and which show signs of modification of structure as a result. Whether the organism ever exists in an entirely free condition is uncertain. Most of the specimens suggest attachment in some form or other, if only to loose sand. In one instance the test is attached to the free tube of an Annelid, and probably started its growth later than the worm

These free or semi-free specimens differ from the fixed type in the shape of the initial portion which, instead of being an outspreading pad, takes the form of an irregular bulb with comparatively thin walls and a large internal cavity (Figs. 11, 16). The cavity is usually undivided, but is sometimes filled with a labyrinthic agglomeration of large sand-grains, the interspaces of which are probably homologous with the branching passages in the basal pad of the sessile form.

The external wall of the bulb is often furnished with projecting spicules (Fig. 16), which may serve the purpose of anchoring the bulb in an upright position in the mud of the sea-bottom. Occasionally there are accessory simple orifices on short tubular outgrowths. The proportion of spicules to grey mud and cement is noticeably less in the early stages of the bulbous form than in the sessile type.

Following the bulbous initial portion the plan of growth follows the normal plan, the trunk rapidly diminishing in diameter to the first furcation and the proportion of spicular material simultaneously increasing (Fig. 11).

There can be no doubt as to the affinities of this striking species. The unseptate columnar tube and the branching passages of the basal pad mark it unquestionably as an Astrorhizid, and, except in the existence of this specialised base and the neat construction of the test, our species is evidently closely allied to *Dendrophrya erecta*, Strethill Wright. The structure of the basal pad so closely resembles *Masonella* as to indicate that the genus forms a connecting link between the genera *Astrorhiza*, *Masonella*, and *Dendrophrya*.

The species occurs only in material from the New Zealand area, but is probably abundant in suitable localities. A considerable number of fragments have been found, but no perfect specimens, owing to the character of the material. The largest number of fragments were obtained at Station 6.

At Station 4 the spicules were abnormally large as compared with the diameter of the branches into which they were built (Fig. 14). In one fragment, from Station 6, the spicules are arranged spirally (Fig. 15), as in *Marsipella spiralis*, H.-A. & E., thus departing from the normal method of inlaying them parallel to the axis of the branch.

Size.—The maximum height of a perfect specimen can only be estimated, but probably it may attain 5 or 6 mm. The basal pad of sessile specimens ranges up to 2 mm. in diameter, and the bulbous base of free specimens up to 1·30 mm. The tubes vary between ·10 and ·70 mm. external diameter, according to their proximity to the base.

75. *Dendronina arborescens*, var. *antarctica*, nov. Pl. II, figs. 13, 19.

Basal pad small, labyrinthic, surmounted by a short, stout trunk roughly constructed of sand-grains, spicules and cement. Surface smoothly finished. Colour dark grey, due to the minerals incorporated in the cement.

This variety is based on two specimens only, one each from Stations 45 and 55. They are both sessile organisms, but detached from the host and exhibiting a labyrinthic structure of the base, as in *D. limosa*, var. *humilis*. Both are fragmentary, inasmuch as they terminate abruptly at the trunk stage; but one of the specimens (Fig. 19) exhibits a broadening at the point of fracture, which probably indicates a branching of the trunk.

In their construction and appearance they appear to be more clearly allied to the New Zealand form, *D. arborescens*, than to the Antarctic *D. limosa*, var. *humilis*.

Dimensions of the two specimens are as follows:—

Basal pad, ·70 and 1·0 mm. diameter. Height of trunk to point of fracture, 1·0 and 2·10 mm.; breadth of trunk, ·30 and ·40 mm.

76. *Dendronina limosa*, sp. nov. Pl. II, figs. 1–6.

Test sessile or free, consisting of a swollen basal chamber with entire or labyrinthic cavity. From the basal chamber arise one or more tubular extensions, unseptate and of gradually diminishing diameter. The tubes are usually simple, but a single instance of furcation has been observed. Aperture terminal and simple, formed by the constriction of the terminal end of the tube. Test constructed of fine mud and sand-grains with little cement, surface rather rough, colour yellowish grey. Walls of basal chamber and tube rather thin, much thinner than in *D. arborescens*, with the result that the bore of the tube is considerably larger than in that species. No spicules are employed in the construction of the test, and the organism is in consequence very fragile, though possibly more or less flexible in the living state. In some apparently free-growing specimens the basal chamber is surrounded with a cheval-de-frise of projecting spicules (Figs. 2, 3). It is possible that these may have been incorporated for anchoring purposes, but it is more probable that the specimens were loosely attached to a living sponge.

Confined to the New Zealand area, where it occurs in company with *D. arborescens*. It may be regarded as a primitive type of the genus. Owing to its extreme fragility the specimens are in a less perfect condition than the types of that species, but it is probably equally abundant under suitable conditions.

Size:—The basal chamber in both free and sessile specimens ranges up to 1·20 mm. Maximum height unknown, but probably does not exceed 2 or 3 mm. Thickness of wall varies from ·12 mm. at the base to ·03 mm. at the extremities of the tubes, which average ·30 mm. in diameter.

77. *Dendronina limosa*, var. *humilis*, nov. Pl. II, figs. 7–9.

Station 26.

Test sessile, composed of fine sand-grains and a little cement, but without incorporated sponge-spicules. Consisting of a basal portion with labyrinthic

interior, surmounted by a single stout columnar trunk or tube, but slightly smaller in diameter than the basal portion, passing into a simple tube and terminating abruptly in a constricted nipple-shaped aperture. Colour dark grey. Walls thin and smooth, but unpolished.

The specimens found were detached but had originally been sessile on some other body. The labyrinthic structure of the base was in all cases exposed, and as the specimens showed no signs of wear or disruption, it would appear that the organism is very loosely attached to its host, and that there is no pavement-layer separating the protoplasm from the surface of the host, such as is present in *D. arborescens*, other than perhaps such a chitinous film as occurs in *Iridia*.

The affinities are clearly with *D. limosa*, in fact the Antarctic variety closely resembles young individuals of that species from the New Zealand area, except in its markedly labyrinthic base, and its more depressed habit and massive construction.

Size :—The base ranges from ·70–1 mm. in diameter, and the maximum height is about the same. The tube averages ·20–·40 mm. in diameter.

Sub-Family PILULININAE.

BATHYSIPHON, Sars.

78. *Bathysiphon filiformis*, M. Sars (M.S.).

Bathysiphon filiformis, G. O. Sars, 1871, Vidensk.-Selsk. Forhandl., p. 251.
.. .. Brady, 1884, FC. p. 248, pl. xxvi, figs. 15–20.
.. .. de Folin, 1887, B. p. 279, pl. vi, figs. 4 *a–e*.

Station 29.

Two fragments referable to this species. It is possible that the two doubtful specimens referred to *B. argenteus* should be referred to this species.

79. *Bathysiphon rufum*, de Folin.

Bathysiphon rufum, de Folin, 1887, B. p. 283, pl. vi, figs. 8 *a–c*.

Station 40.

A few individuals characterized by a light colouring which deepens into orange bands at points marking slight constrictions in the shell.

80. *Bathysiphon argenteus*, Heron-Allen and Earland.

Bathysiphon argenteus, Heron-Allen and Earland, 1913, CI. pl. iii, figs. 1-3; 1916, FWS., p. 218.

Stations 2, 42, 43, 44.

The records depend upon an undoubted specimen from Station 2 (N.Z.), and a similar one from Station 44. At Stations 42 and 43 were found fragments which are less distinctive but are probably referable to this species.

Sub-family SACCAMMININAE.

PSAMMOSPHAERA, Schulze.

81. *Psammosphaera fusca*, Schulze. Pl. I, fig. 18.

Psammosphaera fusca, Schulze, 1874, R. p. 113, pl. ii, fig. 8.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 609.

Stations 1–3, 6–10, 16, 18, 21–25, 27, 29–33, 36, 37, 41, 42, 45, 47, 48, 50, 51, 53–55 (+ T. d. F., D.).

Almost universally distributed. The best N.Z., at Station 6, where it is abundant and presents the entire range of variation described and figured in our 1913 paper (H.-A. & E., 1912, etc., NSG. 1913, p. 1, pls. i–iii), from large, spherical, roughly-built free specimens, down to sessile individuals entirely composed of the finest mud. One individual deserves especial remark, sessile, low-domed, constructed of coarse sand-grains, but having three radiating tubules of fine sand, extending to some distance from the edge. At Stations 2 and 3 (N.Z.), and 53 and 55 (Antarctic) the large free spherical forms, in many instances, have a long sponge-spicule built into the edge of the wall and projecting, but not traversing the central cavity as in *P. parva*. The best Antarctic series were obtained at Stations 29 and 50, large and very rough; at Stations 21 and 32, the only Antarctic sessile specimens.

82. *Psammosphaera fusca*, var. *testacea*, Flint.

Psammosphaera fusca, var. *testacea*, Flint, 1899, RFA. p. 268, pl. viii, fig. 2.
,, ,, ,, ,, Heron-Allen and Earland, 1912, etc., NSG. 1913, p. 18, pl. ii, fig. 9.

Station 6.

A few typical specimens of this doubtfully separable species.

83. *Psammosphaera parva*, Flint.

Psammosphaera fusca, de Folin, 1895, SRR. p. 16, pl. O, figs. 4, 5.
,, *parva*, Flint, 1899, RFA. p. 268, pl. ix, fig. 1.
,, ,, Heron-Allen and Earland, 1912, etc., NSG. 1913, p. 17, pl. ii, figs. 7, 8.

Stations 2, 15, 32, 40.

The records are few, and none of the specimens are very distinctive.

84. *Psammosphaera bowmanni*, Heron-Allen and Earland.

Psammosphaera bowmanni, Heron-Allen and Earland, 1912, etc., NSG. 1912, p. 385, pl. v, figs. 5, 6, pl. vi, fig. 5; 1913, CI. p. 39; 1916, FWS. p. 219.
,, ,, Cushman, 1918, etc., FAO. p. 36, pl. ix, figs. 5, 6; pl. x, fig. 5.

Stations 3, 6.

It is of great interest to us to record the presence of this interesting form from a new area. Three specimens occur, one at Station 6, quite typical,

differing only from the British specimens in that the cement is white and calcareous, and thus contrasts sharply with the dark mineral flakes composing the test. In two others, at Station 3, which are less typical, short, broken sponge-spicules being used to form the rough framework, the "windows" being filled in with flat mineral flakes. They represent a passage-form between *P. rustica* and *P. bowmanni*.

85. *Psammosphaera rustica*, Heron-Allen and Earland.

Psammosphaera rustica, Heron-Allen and Earland, 1912, etc., NSG. 1912, p. 383, pl. v, figs. 3, 4; pl. vi, figs. 2–4; H.-A. 1915, RPF. p. 268.
" " Cushman, 1918, etc., FAO, p. 37, pl. v, figs. 3, 4; pl. vi, figs. 2–4.

Stations 2, 3, 6, 41, 55.

Occurs in both areas. In the N.Z. the most abundant at Station 6. All the N.Z. specimens are of rougher construction than the British, in many cases sand-grains are utilised almost as much as spicules, and the projecting "scaffold" spicules are, to a large extent, suppressed, but in a few instances, notably at Station 6, these projecting spicules are very prominent, and the specimens are typical. In the Antarctic area the records are few. At Station 41, both sand and spicules are used, but the formation is otherwise typical. At Station 55 a single very large example, in which the projecting spicules are very large and numerous, radiating in all directions. At Station 2 a single large association of individuals such as is not uncommon in the North Sea, but without projecting scaffolding. It seems possible that Cushman's *Rhabdammina cornuta*, var. *spiculotesta* (C., 1918, FAO. p. 18, no fig.), may be founded upon similar associations, but in the absence of a figure we are not prepared to go further than this.

SOROSPHAERA, Brady.

86. *Sorosphaera confusa*, Brady.

Sorosphaera confusa, Brady, 1879, etc., RRC. 1879, p. 28, pl. iv, figs. 18, 19; 1884, FC. p. 251, pl. xviii, figs. 9, 10.

Station 26.

The specimen is not satisfactory, but should, we think, be attributed to this species, if, indeed, the genus be allowed to stand. The records depend upon Brady's "Challenger" Report, and a specimen recorded by Cushman from the Atlantic in 1,467 fms., which he notes as "very typical" (C., 1918, etc., FAO, p. 39, pl. xv, figs. 4, 5). Pearcey also records it from the Weddell Sea in the Antarctic.

We have always had some doubts as to the validity of this genus, and an examination of Brady's type-specimen, apparently the one represented by Fig. 10. (*ut supra*), in the British Museum, satisfies us that this specimen at any rate, is nothing more than an association of individuals of *Thurammina papillata*, var. *cariosa*, Flint, such as we have referred to in our paper on that genus

(H.-A. & E., 1912, etc., NSG. No. 5, 1917, p. 550, pl. xxix, figs. 1–11). Until all Brady's specimens have been found and identified the question of *Sorosphaera* must remain in abeyance, but it seems highly probable that it represents merely agglomerated associations of different varieties of *Thurammina*, such as we have figured (*loc. cit.*) on pl. xxx, under the name *T. papillata*, var. *canaliculata*, Haeusler, and var. *elegantissima*, Haeusler.

SACCAMMINA. M. Sars.

87. *Saccammina sphaerica*, M. Sars. Pl. I, fig. 16

Saccammina sphaerica, M. Sars, 1868, LUHD, p. 248.
,, ,, Cushman, 1910, etc., FNP. 1910, p. 39, figs. 33-36.

Stations 2, 7, 26, 29, 33, 40, 50, 53, 55.

The records are few, but the specimens are very good, the largest and best at Station 2. Other large individuals at Stations 29, 40 and 55. At Station 53, two specimens of the roughly constructed, wide-mouthed and spiculiferous form figured in our paper (NSG. No. 2, 1913, pl. i, figs. 15-19), for which Cushman proposes the varietal name *anglica* (C., 1918, FAO. p. 45). At Station 50, a very small specimen with neatly constructed tubular mouth resembling Rhumbler's *S. minuta* (R., 1909, etc., FPE. 1909 (1911), pl. i, figs. 8, 9; 1913, p. 375. See C., 1918, FAO, p. 46, pl. 20, fig. 5.) We figure an abnormal specimen from Station 2. It apparently represents a malformed and broken *Saccammina*, in the broken cavity of which is a mass of protoplasm and metaplastic bodies which protrudes through the aperture of the *Saccammina* and extends in an unseptate tube constructed of fine mud and cement (*cf.* Rhumbler, 1884, Zeitschr. wiss. Zool., vol. lvii, p. 489, pl. xxii, figs. 23-24a). The specimen, including tube, measures 7 mm.

Sub-Family RHABDAMMININAE.

JACULELLA, Brady.

88. *Jaculella acuta*, Brady. Pl. I, figs. 19, 20.

Jaculella acuta, 1879, etc., RRC. 1879, p. 35, pl. iii. figs. 12, 13.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 609.

Stations 6, 29.

The records depend on a single Station in each area. At Station 6 a series of individuals was found ranging up to 10 mm. in length, presenting very marked idiosyncrasies in their construction. The outer wall of the test is built up of a firmly agglutinated crust of relatively small sand-grains, incorporated with ferruginous cement to form a comparatively smooth wall, dark in colour owing to the large proportion of heavy minerals built in. At the terminal portion of the test a mass of very loosely aggregated clear siliceous sand-grains, larger than those employed in the construction of the wall, is heaped together without any investing wall. So far as can be judged in the absence of sections, it appears

that these N.Z. specimens have the interior of the cone filled with this loosely aggregated mass. It would thus seem that *Jaculella*, in constructing its test, utilises the heavy minerals selected from its environmental material, for wall-building only. Two forms showing this method of construction are found, one with a pointed base, the other with a bulbous proloculum. No doubt these represent the megalospheric and microspheric forms.

In the Antarctic the species is represented by a single typical example of coarse construction, resembling Brady's fig. 14 (1884, F.C. pl. xxii).

89. *Jaculella obtusa*, Brady.

Jaculella obtusa, Brady, 1882, FKE. p. 714; 1884, FC. p. 256, pls. xxii, fig. 19–22.
,, ,, Goës, 1894, ASF. p. 20, pl. iv, figs. 87–89; pl. v, figs. 90, 91.

Station 6, 13, 32 (+ D.).

Good and typical specimens, one of great length from Station 32.

HYPERAMMINA, Brady.

90. *Hyperammina vagans*, Brady.

Hyperammina vagans, Brady, 1879, RRC. etc., 1879, p. 33, pl. v, fig. 3.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 610.

Stations 1–3, 6, 16, 25, 26, 29, 32, 37, 38, 49 50, 55.

The best examples at Stations 6 (N.Z.) 29 and 14 (Antarctic). Other good specimens at Stations 32 and 35. At the remaining Stations the species is represented by more or less unquestionable fragments.

91. *Hyperammina ramosa*, Brady. Pl. I. fig. 13.

Hyperammina ramosa, Brady, 1879, etc., RRC. 1879, p. 33, pl. iii, figs. 14, 15.
Saccorhiza ,, Cushman, 1910, etc., FNP. 1910, p. 65, fig. 81.

Stations 3, 6, 7, 9, 10, 25, 28, 29, 32, 33, 40, 41, 48, 55.

Usually occurring in fragments, but often in considerable abundance. The method of construction varies according to the nature of the bottom deposit. Where sponge-spicules are available the species has a marked tendency to incorporate these, projecting from its test. This habit is well shown at Stations 6 and 29. At other Stations the test is built of sand-grains usually somewhat roughly. At Station 10 the specimens were entirely constructed of *Globigerinæ* and other Foraminifera, which is startling, regard being had to the depth as given on the label (see our note on the material). At Station 28, where the specimens were otherwise normal, one large fragment was found in which the apertural ends were blocked up with sandy mud incorporating young megalospheric individuals of *Cornuspira involvens* to the number of at least twenty. This appears to us to be accounted for only, if the *Hyperammina* were ingesting

mud for building purposes on the precise spot where a young brood of *C. involvens* had just been hatched out. The record of the species at this Station rests entirely on these individuals.

92. *Hyperammina arborescens*, Norman.

Psammatodendron arborescens (Norman MS.), Brady, 1881, HNPE. p. 98, No. 13.
Hyperammina ,, Brady, 1884, FC. p. 262, pl. xxviii, figs. 12, 13 (fig. 10, p. 263).

Station 48.

A single recognisable branching fragment.

93. *Hyperammina elongata*, Brady. Pl. I, fig. 21.

Hyperammina elongata, Brady, 1878, RRNP. p. 433, pl. xx, fig. 2*a*, *b*.
,, ,, Cushman, 1910, etc., FNP. 1910, p. 60, figs. 73, 74.

Stations 6, 22, 26, 27, 37, 41, 52, 55 (+ D.).

Two distinct types of structure occur among the specimens referable to this species. The normal, in which the test is built up of sand-grains firmly cemented together and with more cement than is found in any other species of *Hyperammina;* the outer surface is at times quite rough, at others smoothly agglutinated. The other type utilises spicules, sometimes in part, and sometimes *in toto*, in the construction of its test, and occasionally these spicules are arranged in two distinct layers set longitudinally and transversely with a neatness equal to that displayed by *Technitella* (*Cf.* H.-A. & E., 1912, etc. NSG. 1912, p. 382, pl. v, figs. 1, 2). At Station 6, where the species is most abundant, both types occur, and the specimens also fall into two distinct groups in each type a long, narrow tube agreeing with Brady's figures, and a short and much more massively built organism, which at times evidently attains a considerable size. The arenaceous type occurs alone at Stations 26, 27, 37, and 41, all of the small and slender type. At Stations 52 and 55 the spiculiferous type occurs alone, but using sand-grains in about equal proportions to the spicules.

This spiculiferous habit, although more predominant among the N.Z. specimens than we have observed elsewhere, is not confined to the N.Z. area; we have identical specimens from several deep-water Stations round the British coast, and it may be noted with interest that Brady's type-slide of the species in the British Museum contains a similar specimen, although he makes no reference to the habit in his published description. This spiculiferous habit extends to all the other species of *Hyperammina*, notably to *H. ramosa*, which invariably uses spicules if they are attainable. *H. mestayeri*, Cushman (C. 1919, RFNZ. p. 596, pl. lxxiv, fig. 3) from the N.Z. area—which the author states is evidently related to *H. friabilis*, Brady—no doubt occupies the same position with regard to that species that our spicular variety of *H. elongata* does to the normal type, and the habit is not confined to the N.Z. area, as we have spicular

H. friabilis from the N. Sea (330 m. "Goldseeker" Station ix, B.). De Folin, under the name of *Hyperammminella venusta* (de F. 1881, RRT, p. 140, and de F. 1887, RR, p. 114, fig. 9) figures the proloculum of a broken specimen from the Bay of Biscay which might have been drawn from one of the N.Z. examples of *H. elongata*.

94. *Hyperammina elongata*, var. *laevigata*, Wright.

Hyperammina elongata, var. *laevigata*, Wright, 1891, SWI. p. 466, pl. xx, fig. 1.
" " " " Cushman, 1910, etc., FNP. 1910, p. 61, fig. 75.

Stations 6, 10, 25, 29, 33, 40, 41.

Represented, as a rule, by a few specimens at each Station, generally fragmentary. At Station 10 the construction is rougher than usual, passing almost imperceptibly towards the type. At Station 25, in addition to the normal type, which is perfect but small, a minute specimen was found with a chitinous test shewing adventitious material deposited in a few patches only.

Wright appears to have been anticipated in his discovery of var. *laevigata* by Haeusler who, in 1885 (H. 1885, LAI, p. 26, pl. iii, fig. 23) figures a broken individual, and in 1890 (H. 1890, FST, p. 61, pl. ix, fig. 48) a perfect specimen, both under the name of *Ammodiscus filum*, Schmid; but the *Serpula filum* of Schmid (S. 1867, ZSW, p. 583, pl. vi, fig. 48) is quite different, obviously *Ammodiscus gordialis*, or a variety closely akin. Wright's name, therefore, stands in spite of Haeusler's anticipation, unless the fossils described by Howchin (H. 1888, ACF, p. 535, pl. viii, figs. 1, 2) under the name *H. elongata*, var. *clavatula*, prove to be identical with Wright's organism. The figures certainly bear considerable resemblance, but Howchin, who appears to have been familiar with recent specimens referable to var. *laevigata*, to which he refers as "smooth examples of *H. elongata*, Brady," differentiates his variety "by their minute dimensions, the proportionately larger size of its primordial chamber and its shorter contour," though he suggests that the latter feature may be due to the broken condition of his fossils.

95. *Hyperammina elongata*, var. *tenuissima*, nov. Pl. I, fig. 17.

Station 29.

Test finely arenaceous, smooth, polished, commencing with a bulbous primordial chamber more than twice the diameter of the tube, which is of practically even diameter throughout its entire length. Colour, pale brown.

This variety differs from Wright's var. *laevigata* (a) in the abnormal length of the tube, which in the largest fragment observed attained 1·5 mm., and (b) in the primordial chamber, which is swollen and club-shaped instead of fusiform, as in Wright's variety. Owing to its extreme fragility, probably none of the specimens found are perfect.

The specimens bear considerable resemblance to the starved form of *Webbina clavata*, which occurs in some of our North Sea dredgings, but these support the delicate tubular extension by incorporating a sponge-spicule at intervals in the side of the tube, whereas the Antarctic specimens which we are describing are entirely free.

The longest fragment measures 1·50 mm. with a maximum breadth ·04 mm. It has no proloculum. Diameter of proloculum in another specimen (broken), measuring ·97 in length, was ·09 mm.

96. *Hyperammina novae-zealandiae*, nom. nov. Pl. III, figs. 1–5.

Technitella mestayeri, Cushman, 1919, RFNZ. p. 595, pl. lxxiv, fig. 4.

Station 6.

Test free, elongate, circular in section, slightly tapering, straight tending to arcuate. Built almost entirely of sponge-spicules in two layers, the outer layer laid longitudinally, the inner transversely. The outer layer is evidently constructed subsequently to the inner layer as the oral end of the shell often exhibits the inner layer only of the last few courses of spicules laid down. Surface variable, sometimes smooth and neatly constructed, at others with the points of the spicules projecting in the direction of the proloculum. Occurring in two forms, (*a*) megalospheric, with a bulbous proloculum, followed by a constriction, or sometimes by several constrictions at intervals, (*b*) microspheric, tapering very gradually from the proloculum, which is missing in all the specimens we have observed, but must be quite small as compared with form (*a*). Form (*b*) attains twice the length of form (*a*). Interior of the test more or less sub-divided by constricted rudimentary septation, visible externally in some cases as a slight depression.

Station 6 in the N.Z. area was characterized by the abundant specimens of this curious and somewhat abnormal species. We were at first inclined to assign them to, or near, *Technitella raphanus*, Brady, but an examination of Brady's type-slide in the British Museum shows essential differences. The examination of specimens in balsam reveals the fact that the cavity of the N.Z. specimens is not monothalamous but is divided by rudimentary septa into chamberlets. This brings the form into close affinity with *H. subnodosa*, Brady, and the spiculiferous habit being found in other species of *Hyperammina* there is less reason to doubt the assignations of the N.Z. specimens to that genus. We have not observed the development of the spiculiferous habit in *H. subnodosa* to an equal extent with the other species, but specimens from S.W. Ireland (550 fms.) exhibit a tendency to incorporate spicules in large quantities, together with the sand-grains employed.

There can be very little doubt that the two small specimens described by Cushman from N.Z., under the name of *Technitella mestayeri*, represent young

individuals of our form. We regret our inability to use his specific name, but Cushman himself having employed the name *mestayeri* for another species of *Hyperammina*, the name *T. mestayeri* must lapse.

The species varies greatly in size, the megalospheric form ranging between 2 and 7 mm. in length, and the microspheric between 2 and 5 mm.

MARSIPELLA, Norman.

97. *Marsipella elongata*, Norman. Pl. III, figs. 10–12.

Marsipella elongata, Norman, 1878, H. p. 281, pl. xvi, fig. 7 (3 on the plate).
" " Brady, 1884, FC. p. 264, pl. xxiv, figs. 10–19.

Stations 2, 6.

Confined to the N.Z. area. At Station 2 only two specimens were found, one entirely built of sponge-spicules, the other constructed, as normally, of coarse sand-grains. At Station 6, where it was common, two very distinct forms occur, one constructed with great neatness, entirely of spicules, the other with the body of the test built of coarse sand-grains, but having produced tapering extremities entirely spicular.

The spiculiferous form is unquestionably the *Dioxeia richardi* of de Folin (de F. 1887, RR. p. 115, fig. 11 and "Sous les Mers," 1887, p. 130, fig. 17). *Trioxeia edwardsi* de Folin ("Sous les Mers," p. 130, fig. 16) appears to be nothing more than an abnormal form, presenting three apertures. Some of the N.Z. individuals are almost identical with it, and one, which we figure from Station 6, is clearly the same organism.

98. *Marsipella cylindrica*, Brady.

Marsipella cylindrica, Brady, 1882, BKE. p. 714; 1884, FC. p. 265, pl. xxiv, figs. 20–22.
" " Heron-Allen and Earland, 1912, etc., NSG. 1912, p. 388, pl. v, figs. 8, 9; pl. vi, figs. 8, 9.

Stations 6, 9, 13, 16, 22, 27, 29, 40, 49, 52.

Occurs in both areas most abundantly and the finest specimens at Station 6. It reaches a considerable length and is almost entirely spiculiferous. At Station 29 the individuals again use the spicular selective construction. At Stations 22, 27 and 40, sand and spicules are employed indifferently, at the remaining Stations sand only.

99. *Marsipella chapmani*, nom. nov. Pl. III, figs. 8, 9.

(?) *Marsipella cylindrica*, Chapman, 1914, FORS. p. 62, pl. ii., fig. 15.

Stations 2, 3, 6.

Test monothalamous, constructed entirely of sponge-spicules, usually unbroken, arranged with a pronounced sinistral twist. Normally slightly curved, but occasionally strongly arcuate. Tapering gradually from the initial end, which is closed

and blunt, to the other extremity, which, in all the specimens found, is more or less ragged and unfinished. The spicules are cemented neatly side by side with a very thin layer of colourless cement, the whole test glistening, owing to the exposed surfaces of the spicules, which are only one layer deep. The aboral extremity of the test presents no visible aperture, but is probably coarsely perforate, as nearly all the examples exhibit dried protoplasm projecting upon the surface from the extremity.

Abundant at Station 2, a few specimens at Station 3, and a single individual at Station 6.

Whether the organism is perfect, or merely a fragment of some larger growth, we cannot say. The ragged, unfinished ends which characterize all the specimens would at first suggest that they were broken, but on the other hand, no trace has been found of a corresponding fragment showing a finished extremity. The extrusion of protoplasm from the closed extremity exhibited by most of the specimens may perhaps indicate that the organism anchors itself to some host without becoming definitely sessile, but only one specimen affords evidence in support of this theory, where the organism is attached to the branching tube of a Zoophyte. Chapman, in his Ross Sea Paper, figures and describes (*ut supra*) a specimen which appears to us to be identical with our form and which certainly does not appear to be referable to *M. cylindrica*. He does not give the dimensions of his specimens, but unless his paper is misprinted, they must have been of enormous size, far surpassing anything we have seen—the breadth of the widest end of one of his specimens is given at 13 mm. If this is a misprint for 1·3, it brings it roughly into agreement with the size of our specimens, which we take this opportunity of associating with his name.

The size is very variable. The largest fragment measured 11·20 mm. in length, and was ·50 mm. broad at the initial end and ·80 mm. in diameter at the fractured extremity.

RHABDAMMINA, Brady.

100. *Rhabdammina abyssorum*, M. Sars.

Rhabdammina abyssorum, M. Sars, 1868, LUHD. p. 248 (*nomen nudum*).
„ „ Cushman, 1910, etc., FNP. 1910, p. 24, figs. 8–10.

Stations 6, 8, 16, 21, 22, 29, 31, 32, 34, 38, 42, 43, 52.

Fragments attributable to *Rhabdammina*, species indeterminate but almost certainly referable to *R. abyssorum*, occur at many Stations.

101. *Rhabdammina discreta*, Brady.

Rhabdopleura abyssorum, G. M. Dawson, Canad. Nat. 1870, vol. v., p. 177, figs. 6 (7 in plate).
Rhabdammina discreta, Cushman, 1910, etc., FNP. 1910, p. 27, fig. 13.

Station 6 (+ D.).

A single very large specimen, utilizing sponge-spicules. The species was figured by G. M. Dawson in 1870 (*ut supra*) as *Rhabdopleura abyssorum*, but the

genus *Rhabdammina* had been founded by Sars in 1868, and the specific name *abyssorum* had been already used for a distinct form, and Dawson's generic and specific names have therefore disappeared.

RHIZAMMINA, Brady.

102. *Rhizammina algaeformis*, Brady.

Rhizammina algaeformis Brady, 1879, etc., RRC. 1879, p. 39, pl. iv., figs. 16, 17.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 611.

Stations 3, 4, 6, 26, 27–29, 38, 40, 45, 48, 51, 53, 55.

Occurs in both areas. The best Stations are 26, 28, 38 and 55. At the last Station the best examples were obtained. There is, as usual, a very wide range in the method of construction. Some of the fragments are merely collapsible chitinous tubes with a mud coating, at others a considerable amount of rigidity is attained by agglutination of sand-grains, and, at Station 6, of minute Foraminifera.

Family LITUOLIDAE.

Sub-Family LITUOLINAE.

REOPHAX, Montfort.

103. *Reophax difflugiformis*, Brady.

Reophax difflugiformis Brady, 1879, etc., RRC. 1879, p. 51, pl. iv., fig. 3.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 612.

Stations 2, 8, 9, 13, 16, 18, 21, 22, 25, 28, 29, 32, 33–35, 40–42, 44–46, 50, 52, 55 (+ D.).

Very generally distributed, but the number of specimens usually small. In the N.Z. area it is somewhat rare, but at Station 9 a curious and interesting variety, composed of mica-plates, occurs. The specimens may be roughly differentiated into those constructed of coarse sand-grains without visible cement, and those built of fine grains with a greater or less quantity of ferruginous cement. The coarsely-constructed forms predominate and occur exclusively at the majority of Stations, but at Stations 32 and 40 both forms occur and run into one another. At Station 28 a variety occurs in which the neck is very long, sometimes twice the length of the body, constructed of very fine sand and cement. At Station 29 the same form occurs and is particularly noticeable, the delicately constructed neck projecting from a body built of larger and coarser sand-grains than usual. The southernmost specimens are perhaps larger and more robust than those from northerly Stations, noticeably so at Station 41, where the species is frequent. A globular type (*cf. Haplophragmium scruposum*, Berthelin (B. 1880, EAM. p. 21, pl. i (xxiv), fig. 1), occurs. The same form, but rather more ovate, occurs at Station 50, in company with an isomorph of *Lagena laevis*, both being

large and coarsely built. At Station 55 a large broken specimen, largely built up of spicules, is apparently referable to Cushman's *Proteonina ovata* (C. 1910, etc., FNP. 1910, p. 43, fig. 43).

[The many varied forms of this species are isomorphic with the hyaline series *Lagena apiculata* (Rss.) to *L. laevis* (Mont.).]

104. *Reophax ampullacea*, Brady.

Reophax ampullacea Brady, 1879, etc., RRC. 1881, p. 49, FC. p. 290, pl. xxx., fig. 6.

Station 40 (+ D.).

A single specimen.

[Hyaline isomorph, *Lagena laevigata* (Rss.), and associated forms.]

105. *Reophax fusiformis* (Williamson).

Proteonina fusiformis, Williamson, 1858, RFGB. p. 1, pl. i., fig. 1.
Reophax fusiformis, Heron-Allen and Earland, 1916, FWS. p. 222.
,, ,, Millett, 1898, etc., FM. 1899, p. 253, pl. iv., fig. 11.

Stations 6–10, 13, 16, 25, 27, 29, 32, 38, 40, 41, 44, 47, 48, 50, 51 (+ D.).

Widely distributed, but as a rule represented by few and imperfect specimens. This is a species which frequently exhibits a selective tendency, usually for mica. It is worthy of note that Williamson's original coloured figure unconsciously records this fact. Micaceous building was observed at Station 8. At Station 29, mica and garnets are used indifferently, at Station 44 garnets only. The best specimens occur at Stations 27, 29, 32 and 40.

106. *Reophax scorpiurus*, Montfort.

Reophax scorpiurus, Montfort, 1808, CS. vol. i., p. 330, 83e genre.
,, ,, Cushman, 1910, etc., FNP. 1910 p. 83, figs. 114–116.

Stations 2, 3, 6, 11, 16, 18, 25, 26, 28, 29, 33, 38, 40, 42–44, 47 54 (+ R. d. J., D.).

Generally distributed, but usually rare, increasing in abundance towards the south, the best Stations being 44, 47, 48, 50, 53 and 54. At all these Stations the specimens are very dark in colour, owing to the predominance of basaltic sand, contrasting strongly with the quartz-built specimens from the northern Stations.

107. *Reophax pilulifera*, Brady.

Reophax pilulifera, Brady, 1884, FC. p. 292, pl. xxx., figs. 18–20.
,, ,, Cushman, 1910, etc., FND. 1910, p. 85, figs. 117, 118.

Station 6 (+ D.).

A single specimen with produced neck, constructed of fine sand-grains.

[Hyaline isomorph, *Nodosaria soluta*, Rss.]

108. *Reophax advena*, Cushman. Pl. III, figs. 6, 7.

Reophax advena, Cushman, 1919, RFNZ. p. 599, pl. lxxv., fig. 2.

Stations 38, 45, 47, 53, 54, 55.

At a few Antarctic Stations specimens occur of a large, coarsely constructed form, which we have ventured to refer to Cushman's species on the ground of some points of similarity, although our specimens present features which are not referred to in his description. The specimens commence with a large primordial chamber, followed by two to four chambers either in a straight line or in a curve, suggesting relationship with *Haplophragmium*. The colour varies. At the most southerly stations they are very dark owing to the constituents, but at northern stations the natural colour is seen, deep brown at the primordial, owing to the presence of cement, the colour decreasing towards the later-formed chambers.

In most of the specimens the final chamber is seen to be very loosely constructed, without much cement, the sand-grains being separated, and when this loosely constructed layer is broken, the interior of the chamber is found to be labyrinthic, but the labyrinthic structure seems to be confined to the last formed chamber whilst in process of construction, for a section through an adult shell shows that the earlier chambers are non-labyrinthic. Very young specimens consisting of only two chambers are difficult to identify, except by association with adults; in external appearance they are practically indistinguishable from double individuals of *Saccammina sphaerica*.

109. *Reophax dentaliniformis*, Brady.

Reophax dentaliniformis, Brady, 1879, etc., RRC. 1881, p. 49; 1884, FC. p. 293, pl. xxx, figs. 21, 22.
.. .. Cushman, 1910, etc., FNP. 1910, p. 87, fig. 121.

Stations 29, 38, 40, 45, 46, 49, 50, 52, 53.

Confined to the Antarctic and increasing in development and size as we proceed further south. The best specimens at Stations 49, 50 and 52, especially the last. All very dark in colour owing to the incorporation of basaltic sand.

110. *Reophax bacillaris*, Brady.

Reophax bacillaris, Brady, 1879, etc., RRC. 1881, p. 49; 1884, FC. p. 293, pl. xxx, figs. 23, 24.
.. .. Cushman, 1910, etc., FNP. 1910, p. 86, fig. 120.

Station 45.

A single typical specimen. The septation of the chambers in the earlier half of the shell is obscure, and there are only four chambers in the latter half. The aboral end is thick and rounded, and the aperture opens on the face of the last chamber, and is not produced on a neck, as in the type.

[Hyaline isomorph, *Nodosaria pauperata*, d'Orb.]

111. *Reophax longiscatiformis*, Chapman.

Reophax longiscatiformis, Chapman, 1914, FORS. p. 63, pl. iii., fig. 18.

Stations 32, 47.

Recognisable fragments of this curious isomorph of *Nodosaria longiscata*, d'Orb., at both Stations.

112. *Reophax nodulosa*, Brady.

Reophax nodulosa, Brady, 1879, etc., RRC. 1879, p. 52, pl. iv, figs. 7, 8; 1884, FC. p. 294, pl. xxxi, figs. 1–9.
„ „ Cushman, 1910, etc., FNP. 1910, p. 87, fig. 122.

Stations 23, 25, 26, 28, 29, 32, 33, 35, 37, 38, 40, 48, 55 (+ T. d. F., D.).

Confined to the Antarctic and represented as a rule by fragments. The best specimens at Station 28. At Station 29 some good specimens, which probably represent a dentaline microspheric form, characterized by a large number of chambers. They suggest *R. bacillaris*, Brady, but differ in the comparatively coarse construction of the test. At Station 37 a small specimen, consisting of three chambers, very thin-walled, almost chitinous, isomorphous with *Nodosaria soluta*.

[Hyaline isomorph, *Nodosaria farcimen* (Sold.), and allied forms.]

113. *Reophax spiculifera*, Brady.

Reophax spiculifera, Brady, 1879, etc., RRC. 1879, p. 54, pl. iv, figs. 10, 11.
„ „ Cushman, 1910, etc., FNP. 1910, p. 92, figs. 132, 133.

Stations 2, 3, 4, 6, 27, 41, 52.

At a few Stations only in both areas. The Antarctic records rest on three Stations. At Stations 41 and 53 Brady's original type occurs, very well grown. The specimens from the N.Z. area present far greater variety and indicate that they do not represent a true species but are merely spiculiferous isomorphs of various Nodosariae. They are most abundant at Station 6, where they attain a large size and range in form between isomorphs of *Nodosaria filiformis*, *communis*, and *soluta*. At this Station also the species occurs sessile and adapting itself to the contour of the object to which it is attached, isomorphous with *Nubecularia tibia*, Jones & Parker. Similar wild growing isomorphs of *N. lucifuga*, but free, occur at Station 2.

At Stations 2, 3 and 6 individuals occur with long separating stolon-tubes, referable to Cushman's var. *pseudodistans* (C. 1919, RFNZ. pl. lxxv, fig. 1), but in our opinion these would have been better described as spiculiferous specimens of *R. distans*, Brady. At Station 6 one of the individuals was sessile.

[Hyaline isomorphs, *Nodosaria communis*, d'Orb., *filiformis* (d'Orb.) and *soluta*, Rss. Porcellanous isomorphs, *Nubecularia lucifuga*, Defr. and *tibia*, J. & P.]

114. *Reophax cuneta*, Jensen. Pl. III, figs. 13, 14.

Reophax cuneta, Jensen, 1905, Proc. Linn. Soc., N.S.W., 1904, pt. 4, p. 821, pl. xxiii, figs. 5–7 *a*, *b*.

Station 6.

One large specimen, 5 mm. in length, characterized by abnormal accessory chambers added at the oral extremity, a smaller specimen, and two primordial chambers. The extraordinary regularity with which the spicules are laid parallel with the main axis of the test, and their perfection, renders this a most striking object. The pale brown colour is due to the cement used, which, however, is hardly visible, so small is the quantity employed. The parallel spicules give a striate appearance to the test. Some question might arise whether the spicules are selected or secreted, owing to their abnormal regularity, but an examination in balsam shows that the test is composed of two layers of spicules, the inner layer being laid transversely to the outer, and that broken spicules are utilized as well as perfect ones, especially for the inner layer. The swollen primordial chamber is a very noticeable characteristic, and the test is deeper in colour at this end. The protoplasm is dark in colour, and exists in considerable quantities in all the chambers. The general habit of the shell is generally suggestive of *Hormosina*, but for reasons stated under that genus we attribute little value to this generic differentiation.

115. *Reophax distans*, Brady.

Reophax distans, Brady, 1879, etc., RRC. 1881, p. 50; 1884, FC. p. 296, pl. xxxi, figs. 18–22.
" " Cushman, 1910, etc., FNP. 1910, p. 85, fig. 119.

Stations 13, 15, 16, 25, 26–29, 32, 33, 35, 38, 43, 44, 45, 55 (+ D.).

Confined to the Antarctic but ranging over the whole area. Recognizable fragments are all that can be credited to many Stations, but approximately perfect specimens at Stations 27, 29, 32 and 44, at which Stations, judging from the abundance of fragments, the species must have been common.

See our note under *R. spiculifera* (var. *pseudodistans*, Cush.)

[Porcellanous isomorph, *Nubecularia tibia*, J. & P. Hyaline isomorph *Nodosaria inflexa*, Rss.]

116. *Reophax aduncа*, Brady.

Reophax aduncа, Brady, 1882, BKE. vol. xi., p. 715; 1884, FC. p. 296, pl. xxxi, figs. 23–26.
" " Haeusler, 1890, FST. p. 30, pl. iii, fig. 12.

Stations 3, 6 (+ D.).

At these Stations a number of specimens of a minute *Reophax* were found. In their irregular outline and tendency to vary the line of curvature they suggest a relationship to Brady's form, to which we assign them, although they differ in their minute size from the type, which occurs abundantly in some of our deeper water British material and there attains a large size.

117. *Reophax cylindrica*, Brady.

Reophax cylindrica, Brady, 1884, FC. p. 299, pl. xxxii, figs. 7–9.
„ „ Flint, 1899, RFA. p. 274, pl. xviii, fig. 6.

Station 18.

A single perfect and one imperfect typical specimen. This appears to be a very rare form, but there is a southern record, a fragment having been found by the "Challenger" (Station 144) between the Cape of Good Hope and Kerguelen Id. (1,570 fms.). The original specimens were from deep water in the North Atlantic.

HAPLOPHRAGMIUM, Reuss.

118. *Haplophragmium agglutinans* (d'Orbigny). Pl. III, fig. 15.

Spirolina agglutinans, d'Orbigny, 1846, FFV. p. 137, pl. vii, figs. 10–12.
Haplophragmium agglutinans, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 612.

Stations 6, 7, 13, 16, 17, 29, 31, 32, 33, 35, 40, 41.

In the N.Z. area the species occurs abundantly at Station 6 in a large rough-surfaced variety closely resembling *H. coprolithiforme*, Schwager (S. 1867, ZAS. p. 654, pl. 34 (xi), fig. 3). At Station 7 a single normal specimen exhibiting the selection of magnetite, to which we have referred elsewhere (H.-A., 1915, RPF. p. 226, pl. xviii, fig. 62). In the Antarctic area the species exhibits a greater range of variation, but the general tendency is towards depauperate individuals in which the spiral chambers are reduced almost to the point of disappearance, and are followed by a long series of delicate chambers attaining frequently the number of 12 to 20, the entire test reaching a maximum length, ·55 mm. At Station 32 the depauperation is carried to such an extent that the individual chambers are separated by deep sutural depressions and terminated by a produced neck. At the same Station one of these specimens was found sessile on a sponge-spicule. At Stations 16, 33, 35 and 40 a variation occurs in the direction of *H. pseudospirale*, the later chambers becoming notably compressed.

[Hyaline isomorphs. The innumerable variations of this species can nearly all be matched in the equally large number of variations recorded for *Marginulina*. The very pauperate form met with in deep water has a hyaline isomorph in the forms figured by Terquem in his voluminous papers on the Lias of the Moselle (1858–1866). *M. sigma* is perhaps the nearest (pl. xxi, fig. 6).]

119. *Haplophragmium pseudospirale* (Williamson).

Proteonina pseudospiralis, Williamson, 1858, RFGB. p. 2, pl. i, figs. 2, 3.
Haplophragmium pseudospirale, Millett, 1898, etc., FM. 1899, p. 358.

Stations 6, 33, 36, 40.

Very few specimens in both areas. The best Antarctic specimens at Station 40.

120. *Haplophragmium calcareum*, Brady.

Haplophragmium calcareum, Brady, 1884, FC. p. 302, pl. xxxiii, figs. 5–12.
" " Flint, 1899, RFA. p. 275, pl. xix, fig. 1 (error for 2).

Stations 6, 10.

Only in the N.Z. area. At Station 6 it is abundant and attains a large size. The test is constructed very roughly of large sand-grains, smaller grains embedded in cement being used to fill the interstices. The aperture is a narrow slit situated at the end of a produced neck, constructed of finer material. At Station 10 a single specimen utilizing the tests of other Foraminifera as building material was found.

121. *Haplophragmium tenuimargo*, Brady.

Haplophragmium tenuimargo, Brady, 1882, BKE. vol. xi, p. 715; 1884, FC. p. 303, pl. xxxiii, figs. 13–16.
Ammobaculites " Cushman, 1910, etc., FNP. 1910, p. 117, figs. 180–183.

Stations 6, 25 (+ T. d. F.).

An admirable specimen from Station 6 and a more doubtful one from Station 25.

122. *Haplophragmium fontinense*, Terquem.

Haplophragmium fontinense, Terquem, 1867, etc., FOM. 1870, p. 235 (in series), pl. xxiv, figs. 29, 30 *a*, *b*.
Ammobaculites americanus, Cushman, 1910, etc., FNP. p. 117, figs. 184, 185.

Stations 8, 40, 44 (+ D.).

Few records, but the species occurs in both areas. The N.Z. specimens are very coarsely built. Most abundant and exhibiting considerable variation at Station 40. Terquem's species is so well recognised in association with Brady's figure that we cannot agree with Cushman's erection of the well known type into a separate species under the name of *Ammobaculites americanus*, on the ground that Terquem's species is concavo-convex in section. Although Terquem refers to this in his text, his figures are clearly the same as Brady's, and give but the faintest indication of the convexity, probably not more than is indicated in Brady's figure of the species.

123. *Haplophragmium emaciatum*, Brady.

Haplophragmium emaciatum, Brady, 1884, FC. p. 305, pl. xxxiii, figs. 26–28.
" " Cushman, 1910, etc., FNP. 1910, p. 102, figs. 150–152.

Stations 5, 6.

This can only be regarded as a thin-walled variety of *H. canariense*, but it exhibits a striking tendency to build largely of sponge-spicules and micaceous

plates. It is recorded only from Stations 5 and 6, both of which yielded excellent specimens.

124. *Haplophragmium foliaceum*, Brady.

Haplophragmium foliaceum, Brady, 1879, etc., RRC. 1881, p. 50; 1884, FC. p. 304, pl. xxxiii, figs. 20–25.
Ammobaculites ,, Cushman, 1910, etc., FNP, 1910, p. 116, figs. 177–179.

Stations 28, 29, 32, 33, 35.

Few records, but very good specimens at Stations 28, 29, constructed of rather coarser material than is usually the case.

125. *Haplophragmium rotulatum*, Brady.

Haplophragmium rotulatum, Brady, 1879, etc., RRC. 1881, p. 50; 1884, FC. p. 306, pl. xxxiv, figs. 5, 6.
Haplophragmoides ,, Cushman, 1910, etc., FNP. 1910, p. 104, figs. 156, 157.

Stations 6, 8, 13, 32, 40.

This may be described as a *Haplophragmium* of the *canariense* type in which the umbilici are deeply sunk and the peripheral edge truncate. It occurs at a few Stations in both areas, the best at Station 6. It has a normal tendency to utilize coarse material in the construction of its test, and this takes an exaggerated form at Station 40, where the specimens are very rough.

126. *Haplophragmium latidorsatum* (Bornemann).

Nonionina latidorsata, Bornemann, 1855, FSH. p. 339, pl. xvi, fig. 4.
Haplophragmium latidorsatum, Heron-Allen and Earland, 1913, CI. p. 46, pl. ii, figs. 15, 16
,, ,, Millett, 1898, etc., FM. 1899, p. 360.

Stations 6–8, 13, 16, 20, 21, 22–25, 28, 29, 32–36, 38, 40, 42, 44, 51 (+ T. d. F.).

Almost universally distributed but most abundant in the deep water to the S. of N.Z. It presents the usual wide range of variation in size and character of the shell-structure. At the majority of the Stations a very rough habit of construction predominates, due to the incorporation of angular sand-grains, but a smooth type built of finer material also occurs, and becomes more common as one goes south. At some Stations—23, 29, and 35—the two forms occur together.

127. *Haplophragmium scitulum*, Brady.

Haplophragmium scitulum, Brady, 1879, etc., RRC. 1881, p. 50; 1884, FC. p. 308, pl. xxxiv, figs. 11–13.
,, ,, Chapman, 1914, FORS. p. 64, pl. iii, fig. 22.

Stations 6, 10, 13, 22, 26, 29, 31, 32, 33, 38, 40, 41, 43, 44, 51, 52 (+ K. I., R. d. J.).

Widely distributed and fairly abundant at many Antarctic Stations, but never particularly typical. The best examples at Stations 26, 29, 38 and 41.

[Hyaline isomorph, *Nonionina pompilioides* (F. & M.).]

128. *Haplophragmium glomeratum*, Brady.

Lituola glomerata, Brady, 1878, RRNP. p. 433, pl. xx, fig. 1.
Haplophragmium glomeratum, Heron-Allen and Earland, 1913, CI. p. 46, pl. ii, fig. 14.
,, ,, Cushman, 1910, etc., FNP. 1910, p. 104, figs. 158–161.

Stations 16, 27, 29, 32, 33, 36, 40, 44 (+ D.).

Confined to the deeper water between N.Z. and the Antarctic coast line. The number of specimens found was always small, but they are all larger than the average, and extremely well developed.

129. *Haplophragmium canariense* (d'Orbigny).

Nonionina canariensis, d'Orbigny, 1839, FIC. p. 128, pl. ii, figs. 33, 34.
Haplophragmium canariense, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 614.

Stations 1–6, 13, 17, 26, 27, 29, 31, 33, 36, 41, 44–47, 49, 50, 52, 53–5 (+ R. d. J., D.).

Almost universally distributed, but there is a strange gap in the records between Stations 6 and 13. The species is, as everywhere, extraordinarily variable, ranging in the one direction towards *H. emaciatum* and *H. nanum*, and, in the other, towards *H. crassimargo*, the transition between these species being so gradual at some Stations as to defy diagnosis. The tendency to inflation of the chambers is noticeable, particularly at Stations 13 and 29, where the species shows a tendency to pass into the species *H. sphaeriloculum*, Cush. The largest specimens from the N.Z. area occur at Station 3, but there is a general tendency to increase of size as we go south, the Antarctic Stations yielding not only abundant specimens, but large individuals with thicker tests, passing imperceptibly at Stations 45 (which is the best Antarctic Station), 47, 50, 53, 54, 55, into *H. crassimargo*. At Stations 48, 53, and 54 the convolutions are noticeably excentric, and the tendency is to pass into *H. scitulum*. At Stations 26, 45 and 55 specimens pass imperceptibly by gradual distortion into our var. *variabilis*. Station 36 is noteworthy from the fact that though other conditions seem to be favourable, only a single minute specimen was recorded.

[Hyaline isomorph, *Nonionina depressula* (W. & J.), to *N. umbilicatula* (Mont.), and allied forms.]

130. *Haplophragmium canariense*, var. *variabilis*, Heron-Allen and Earland.

Haplophragmium canariense (d'Orb.) Heron-Allen and Earland, 1916, FWS. p. 223, pl. xl, figs. 12, 13.
,, ,, var. *variabilis*, Heron-Allen and Earland, 1916, FSC. p. 41, pl. vi, figs. 1–3.

Stations 26, 38, 45, 46, 47, 48, 53, 54 (+ D.).

The records are confined to the southern areas in the Antarctic Circle. At some of the Stations, noticeably Stations 26 and 38, it attains great profusion and variety of growth, and also considerable size. Every type of malformation conceivable is represented, but perhaps the most noticeable lines of variation

are (*a*) in the reversal of the spiral of growth after a complete revolution, and (*b*) the diversion of the line of growth to a direction at right angles with that originally adopted.

[Hyaline isomorph, *Truncatulina variabilis*, d'Orb.]

131. *Haplophragmium nanum*, Brady.

Haplophragmium nanum, Brady, 1879, etc., RRC. 1881, p. 50; 1881, HNPE. p. 99, pl. ii, figs. 1 *a–c*; 1884, FC. p. 311, pl. xxxv, figs. 6–8.
Trochammina nana, Cushman, 1910, etc., FNP. 1910, p. 123, figs. 190–192.

Stations 3, 6, 13, 26, 29, 33, 45, 46, 53, 54.

This inaequilateral form of the type *H. canariense* occurs in both areas, but reaches its best development in the most southerly Stations, especially at Stations 53 and 54. It passes by imperceptible degrees into the type in one direction and by irregular growth into our variety *H. canariense*, var. *variabilis*, in the other.

[Hyaline isomorph, *Nonionina boueana*, var. *janiformis*, Rupert Jones.]

132. *Haplophragmium crassimargo*, Norman.

Haplophragmium crassimargo, Norman, 1892, Museum Normanianum, pt. viii, p. 17 (Note).
,, ,, Heron-Allen and Earland, 1910, NBF. p. 424, figs. 3, 4; 1913, FNS. p. 130, pl. x, figs. 5, 6; 1914, etc., FKA, 1915, p. 614.

Stations 26, 38, 40, 45, 46, 48, 50.

The records are confined to the Antarctic. The general increase in the size of the type species *H. canariense* as one goes south is probably connected with this distribution, *H. crassimargo* being inseparable by any specific features other than its comparatively enormous size. It is, however, a convenient taxonomical name. The best Stations are Nos. 26 and 45, at both of which it attained a very large size. The variety appears to be subject to wide abnormalities. Station 26 supplied an individual furnished with accessory chambers, developing from the umbilicus. At Station 38 a wild-growing individual isomorphous with *H. canariense*, var. *variabilis* occurs. As in the type species *H. canariense*, the Antarctic specimens are usually very dark in colour, owing to the incorporation of black mineral sand, but at Station 38 specimens of a dark red, owing to the presence of ferruginous cement and an absence of the black sand-grains, were found in company with the dark specimens.

133. *Haplophragmium sphaeriloculum* (Cushman).

Haplophragmoides sphaeriloculum, Cushman, 1910, etc., FNP. 1910, p. 107, fig. 165.
Haplophragmium ,, Sidebottom, 1918, FECA, p. 15, pl. ii, figs. 15, 16.

Stations 6, 17, 18, 22, 33.

This is merely a variety of *H. canariense*, characterized by excessive depression of the sutural lines, thus leading to a spherical inflation of the chambers.

It is a well-marked form and worth separating. Typical specimens occur in both areas, but in very limited numbers, the best at Stations 18 and 22. Seven years later Cushman (C. 1917, NFP. p. 652) uses the same specific name for what he again describes as a new species, without reference to his former paper. The description is differently worded, and in the absence of any figure it is not possible to identify the 1917 species with that of 1910, or indeed with any other specimens.

134. *Haplophragmium globigeriniforme* (Parker and Jones).

Lituola nautiloidea, var. *globigeriniformis*, Parker and Jones, 1865, NAAF. p. 407, pl. xv, figs. 46, 47; pl. xvii, figs. 96–98.
Trochammina globigeriniformis, Cushman, 1910, etc., FNP. 1910, p. 124, figs. 193–195.

Stations 1, 2, 6, 7, 10, 11, 16, 25, 27, 29, 31, 33, 35, 36, 40, 43, 44, 52, 54 (+ D.).

Generally distributed in both areas. The best and most typical specimens at Stations 6, 7, 10 (N.Z.) and 16, 29 and 54 (Ant.). At Stations 16 and 54 the specimens were exceptionally fine and large. At Station 40, all very small. At Station 10 most of the individuals were coarsely built of larger sand-grains than usual.

[Hyaline isomorphs, *Globigerina bulloides*, d'Orb., through *G. dubia*, Egger, to *G. dutertrei*, d'Orb.]

135. *Haplophragmium anceps*, Brady.

Haplophragmium anceps, Brady, 1884, FC. p. 313, pl. xxxv, figs. 12–15.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 615.

Stations 1, 2, 6, 10, 13, 33, 36, 38, 42, 43.

Common to both areas, but best represented at Station 6, where there were a great many excellent specimens characterized by an inordinately large number of chambers. The best Antarctic specimens were at Station 38. At Station 10 a good many specimens characterized by a coarse method of construction as in *H. globigeriniforme* from the same Station.

[Hyaline isomorph, the wild-growing *Textularia concava*, var. *heterostoma*, Forn., referred to in our note on that species and figured in H.-A. & E. 1920, VP. p. 161, pl. xvi, fig. 3.]

136. *Haplophragmium sphaeroidiniforme*, Brady.

Haplophragmium sphaeroidiniforme, Brady, 1884, FC. p. 313.
Ammosphaeroidina " Cushman, 1910, etc., FND. 1910, p. 128, fig. 202.

Stations 3, 6, 7, 9, 10, 11, 12, 13, 22, 33 (+ D.).

A few individuals only from both areas, the largest specimen being the only one found at Station 6.

[Hyaline isomorph, *Sphaeroidina bulloides*, d'Orb.]

NOURIA, Heron-Allen and Earland.

137. *Nouria polymorphinoides*, Heron-Allen and Earland.

Reophax ampullacea, Millett, 1898, etc., FM. 1899, p. 253, pl. iv, fig. 9.
Nouria polymorphinoides, Heron-Allen and Earland, 1914, etc., FKA. 1914, p. 376, pl. xxxvii, figs. 1–15; 1915, p. 615.
„ „ (*Reophax polymorphinoides*, Halkyard), Halkyard, 1919, BMB. p. 22, pl. i, figs. 6, 7.
„ „ Cushman, 1919, RFNZ. p. 601, pl. lxxv, figs. 4, 5.

Station 6.

A few specimens from Station 6, differing from the Kerimba specimens, upon which the species was, in part, originally diagnosed, in the greater proportion of sponge-spicules employed in the construction of the test.

[Hyaline isomorph *Polymorphina compressa*, d'Orb.]

138. *Nouria harrisii*, Heron-Allen and Earland.

Nouria harrisii, Heron-Allen and Earland, 1914, etc., FKA. 1914, p. 376, pl. xxxvii. figs. 16–20.

Station 6.

A single typical specimen.

[Hyaline isomorph, *Polymorphina oblonga*, Will.]

PLACOPSILINA, d'Orbigny.

139. *Placopsilina cenomana*, d'Orbigny.

Placopsilina cenomana, d'Orbigny, 1850, etc., PP. vol. ii, 1850, p. 185, no. 758.
„ „ Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 615.

Stations 2, 3, 6, 29, 31, 32, 40, 54, 55.

Extends over the whole area, the best at Station 6 (N.Z.), and in the Antarctic at Stations 29 and 32. At both these Stations the specimens are sessile upon sponge-spicules, round which the chambers have coiled themselves. At Station 55 specimens are free and wild-growing.

[Porcellanous isomorph, *Nubecularia lucifuga*, Def.]

140. *Placopsilina kingsleyi*, Siddall.

Placopsilina kingsleyi, Siddall, 1886, LMBC. p. 54, pl. i, fig. 1.

Station 48.

At this Station a specimen, attached to a Polyzoon, and constructed of fine mud, spicules, and diatoms, resembles very closely Siddall's figure. Beyond this we are not prepared to go, as the type specimen is not to be found among the Siddall collection, which is in our possession, the specimen being absent from his type-slide.

THOLOSINA, Rhumbler.

141. *Tholosina bulla* (Brady).

Placopsilina bulla, Brady, 1879, etc., RRC. 1881, p. 51 ; 1884, FC. p. 315, pl. xxxv, figs. 16, 17.
Tholosina ,, Cushman, 1910, etc., FNP. 1910, p. 49, fig. 55.

Stations 26, 28, 38, 45, 46, 50, 53, 54, 55 (+ K. I., D.).

Attains its maximum development in the Antarctic area, where it is common, and extremely variable, attached to Zoophytes. There is a wide range in size, the finest specimens being from Station 55. Other large individuals at Stations 38 and 45. At some of the Stations where the species is abundant there is an enormous range in the shape of the individual specimens, from low sessile growths to high-domed, sub-globular, globular attached, and even (at Station 26), globular free. The latter individuals can only be determined by their association with their congeners ; taken apart they would be indistinguishable from specimens of *Thurammina papillata*, Brady. The Antarctic specimens are, as a rule, very dark in colour, owing to the character of the sand-grains, of which the test is composed. At Station 28, attached to stems of a Campanularian, the branching outgrowths from which pass right through the test of the Rhizopod, which has constructed a wall round them.

CRITHIONINA, Goës.

The genus *Crithionina*, instituted by Goës in 1894, cannot be regarded as entirely satisfactory. It probably includes several forms which, though closely related, have no definable connexion with one another. The original diagnosis of the genus is probably responsible for the resultant uncertainty as to its systematic position. Goës' definition was as follows :—"Labyrinthic, or cavernous, or with an undivided central cavity, provided with a sub-cavernous wall, with scanty or indistinct apertures." Of the species originally described, *C. granum* may be regarded as the simplest type, and forms, in its many varieties, a link connecting the other species assigned to the genus. *C. granum* in its external form may, practically, be of any shape—typically it is a compressed sphere. *C. mamilla* is, practically, always sessile, an attached hemispherical body, from the outer walls of which project spicules or shell-fragments, irregularly disposed. In both species the walls are thick, and built up of fine sand-grains, held together with a minimum of cement. In 1896 Goës added three other species to his genus, *C. pisum*, *C. rugosa*, *C. lens*, and variety *C. granum*, var. *sub-simplex*. *C. pisum*, which, in its most typical form, as commonly found in North Atlantic oozes, is a small pea-shaped (pisiform) shell, of smooth exterior, and thick wall, exhibiting, when laid open, but a small central cavity, but which tends, wherever the species occurs in any quantity, to vary in a retrograde direction, towards *C. granum*, and in a progressive direction towards *C. rugosa*, which may be regarded as

a hypertrophied condition, with a rough shell-wall. *C. lens*, on the other hand, presents internal features which differentiate it widely from the type. The central cavity is furnished with radiating extensions, projecting to within a short distance of the periphery, or -to put it in another form—the peripheral wall extends in radial flanges almost to the centre of the cavity. This feature appears to us to connect the genus with *Tholosina*, which, though normally a thin-walled subspherical shell, tends to form accessory chamberlets round the peripheral edge, which, though not visible externally, are exhibited when the shell is laid open, as in the figure given by Goës (G. 1894, ASF. pl. vi, fig. 215).

Like most of the arenaceous Foraminifera, *Crithionina*, though normally free, readily adopts a sessile habit. *C. mamilla* is rarely found in any other condition, and even the occasional free specimens with which one meets have probably become detached from a host. Nearly all the other species which occur in the gatherings are found in both free and sessile condition.

The building material used by *Crithionina*, is, as already mentioned, usually fine sand. Ferruginous cement is never employed, but there appears to be a constant tendency to incorporate sponge-spicules in the test; this tendency reaches its maximum in the variety of *C. pisum*, which was described by Flint (F. 1899, RFA. p. 267, pl. vi, fig. 2) as "var. *hispida*." *C. rugosa* in our Antarctic material tends in the same direction; at Station 38 the specimens showing this tendency are very characteristic. At Station 55 this form occurs both free and attached.

The genus is not represented in the deep water between North Cape, N.Z., and the Antarctic Continent, but is generally distributed in the shallow water gatherings of both areas.

142. *Crithionina granum*, Goës.

Crithionina granum, Goës, 1894, ASF. p. 15, pl. iii, figs. 28–33.
,, ,, Rhumbler, 1903, ZRR. p. 231, fig. 58.
,, ,, Cushman, 1918, etc., FAO. p. 69, pl. xxvi, figs. 6, 7.

Stations 3, 5, 6, 26, 38, 43, 47, 50.

Free and attached at Station 6. Large and typical at Station 38, where the specimens are of dark colour owing to the incorporation of volcanic sand.

143. *Crithionina mamilla*, Goës.

Crithionina mamilla, Goës, 1894, ASF. p. 15, pl. iii, figs. 34–36.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 616.

Stations 2, 6, 26, 29, 38, 48, 50, 55 (+ D.).

The distribution is similar to that of the other species of the genus. At Station 6 it occurs in abundance, and with considerable variety. Some of the specimens are built round large sponge-spicules traversing the mass of the shell,

others are as truly hispid as Flint's variety of *C. pisum*. In the Antarctic area specimens are not so highly developed—they are smaller and in several cases attached to large sand-grains instead of to the normal habitat of Zoophytes or Mollusca. At Station 48 the only specimen was very compressed, and without incorporated fragments or spicules. The best Antarctic specimens were from Station 38.

144. *Crithionina pisum*, Goës.

Crithionina pisum, Goës, 1896, DOA. p. 24, pl. ii, figs. 1, 2.
,, ,, Heron-Allen and Earland, 1909, TNS. p. 410, pl. xxxiv, figs. 6, *a*.
,, ,, Cushman, 1910, etc., FNP. 1910, p. 55.

Stations 2, 3, 6, 25, 26, 38, 41, 45, 47, 48, 50, 53, 54, 55.

Occurs both free and attached. At Station 38, large, and at Station 55 very large. Largest of all, sessile on sponges from Station 25, and from Official Station 294. (No material to hand.)

145. *Crithionina pisum*, var. *hispida*, Flint.

[*Technitella melo*, Norman, *fide* de Folin, 1895. SRR. p. 13, pl. 0, fig. 3.]
Crithionina pisum, var. *hispida*, Flint, 1899, RFA. p. 267, pl. vi, fig. 2.
,, ,, ,, ,, Heron-Allen and Earland, 1909, TNS. p. 410, pl. xxxiv, fig. 7.
,, ,, ,, ,, Cushman, 1910, etc., FNP. 1910, p. 56, fig. 63.

Stations 2, 6, 46.

Very fine specimens at Stations 2 and 6 (N.Z.). In the Antarctic area a single specimen.

146. *Crithionina rugosa*, Goës. Pl. IV, fig. 5

Crithionina rugosa, Goës, 1896, DOA, p. 24, pl. ii, figs. 3, 4.
,, ,, Cushman, 1910, etc., FNP. 1910, p. 53, fig. 59.

Stations 6, 38, 45, 50, 53, 55.

Much more abundant in the Antarctic than in the N.Z. area. Often attains considerable size. The colour varies; at Station 38, very dark, owing to the incorporation of volcanic sand. Both free and sessile at Stations 45 and 55. Hispid varieties isomorphous with Flint's *C. pisum*, var. *hispida*, are generally distributed, we figure one from Station 38. Others were found at Station 55. The sessile specimens, especially of the hispid form, can hardly be separated from *C. mamilla*. Goës, in his description of the species, refers to the fact that *C. rugosa* appears to be closely allied to *C. mamilla*, and it appears to us to be doubtful whether there is any valid reason for the separation of the forms. The main distinctions appear to be the smaller size and generally sessile habit of *C. mamilla*.

C. rotundata, Cushman (C. 1910, etc., FNP. 1910, p. 56, figs 64, 65), appears, to be nothing more than *C. rugosa* attaining super-normal dimensions and having a labyrinthic interior, thus connecting *C. rugosa* with *C. lens*.

147. *Crithionina lens*, Goës. Pl. IV, figs 1, 2.

Crithionina lens, Goës, 1896, DOA, p. 24, pl. ii, figs. 5–8.
,, ,, Cushman, 1910, etc., FNP. 1910, p. 54, figs. 60–62.

Stations 2, 6, 46.

The finest specimens were from Stations 6 (N.Z.), where it occurs both free and attached. The sessile specimens, which were attached to sponges, are with difficulty distinguishable from *Tholosina bulla* (Brady), excepting by their comparatively large dimensions (2 mm. or more). A fine specimen sessile upon one of the stones from Station 2.

Sub-Family TROCHAMMININAE.

THURAMMINA, Brady.

148. *Thurammina papillata*, Brady.

Thurammina papillata, Brady, 1879, etc., RRC. 1879, p. 45, pl. v, figs. 4–8.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 617.

Stations 6, 8, 32, 40.

Beyond a few doubtful individuals the records stand by one typical specimen at Station 6, a small normal specimen and a sub-chitinous example, devoid of papillae, at Station 40.

[Hyaline isomorph, *Orbulina universa*, d'Orb.]

149. *Thurammina papillata*, var. *castanea*, Heron-Allen and Earland.

Thurammina papillata, var. *castanea*, Heron-Allen and Earland, 1912, etc., NSG. 1917, p. 545, pl. xxvi, figs. 14–18; pl. xxix, fig. 17.

Stations 2, 13.

One large specimen at Station 13, and a compressed form at Station 2.

150. *Thurammina papillata*, var. *favosa*, Flint.

Thurammina favosa, Flint, 1899, RFA. p. 278, pl. xxi, fig. 2.
,, *papillata*, var. *favosa*, Heron-Allen and Earland, 1912, etc., NSG. 1917, p. 549, pl. xxviii, fig. 17.

Station 50.

The record rests on a compressed but typical specimen at Station 50.

151. *Thurammina papillata*, var. *haeusleri*, Heron-Allen and Earland.

Thurammina papillata, Haeusler, 1883, ALB. (Ann. Mag. Nat. Hist.), p. 27, pl. viii, figs. 5–8, 11, 13–24; 1890, FST. pp. 46 *et seq.*, pl. vi, figs. 14, 18.
,, ,, var. *haeusleri*, Heron-Allen and Earland, 1912, etc., NSG. 1917, p. 547, pl. xxviii, figs. 1–12; pl. xxix, fig. 16; pl. xxx, fig. 8.

Stations 3, 6, 45–47, 53–55.

Frequent at Station 6, rarer, but well developed at the southern Stations. At Station 47 the specimens are curiously angular in shape, approaching our var.

parallela (*loc. cit. supra*, p. 546. pl. xxvii, figs. 14–17). At Station 53 aggregated individuals near *T. tuberosa*, Haeusler (H. 1890, FST. p. 46, pl. vi, fig. 24; pl. vii, figs. 6–9. H.-A. & E. *ut supra*, p. 548, pl. xxviii, figs. 13–16). At Stations 46 and 53 specimens were built round sponge-spicules.

152. *Thurammina papillata*, var. *albicans*, Brady.

Thurammina albicans, Brady, 1879, etc., RRC. 1879, p. 46; 1884, FC. p. 323, pl. xxxvii, figs. 2–7.
" *papillata*, var. *albicans*, Heron-Allen and Earland, 1912, etc., NSG. 1917, p. 550, pl. xxix, figs. 12–15.

Stations 2, 6, 13, 21, 38.

Many very large and typical examples at Station 6, some of them covered with minute perforations between the projecting papillae, which are very prominent. At Station 21 a specimen was found, the interior containing a compact mass of dark minerals such as we have recorded in our 1917 paper (*ut supra*), p. 551.

HORMOSINA, Brady.

153. *Hormosina globulifera*, Brady.

Hormosina globulifera, Brady, 1879, etc., RRC. 1879, p. 60, pl. iv, figs. 4, 5.
Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 617, pl. xlvi, fig. 25.

Stations 6, 25, 28, 32, 33, 41.

It appears to us that, having regard to our widened range of knowledge of the constructive variability of the arenaceous Foraminifera, the separation of *Hormosina* from *Reophax* is entirely supererogatory. There are many recognised species of *Reophax* which adopt the thin, smoothly-constructed wall upon which Brady appears solely to have erected this new genus, whilst on the other hand, any zoologist who has worked over material in which *Hormosina* is abundant is bound to recognise that the neat, thin-walled method of construction is frequently departed from, and that individuals have no hesitation in incorporating large mineral fragments and other Foraminifera into the walls of their shells. This is especially noticeable in many of our deep-water dredgings off the West coast of Scotland and Ireland, in which the so-called *H. globulifera* is abundant. In view of the widely-accepted status of the genus, however, we confine ourselves for the present to this expression of opinion by way of protest.

The records of *H. globulifera* rest upon an abundant and typical series from Station 6 in the N.Z. area, and a number of recognisable fragments and one perfect monothalamous test, similar to Brady's fig. 1 (FC. pl. xxxix), from the Antarctic area.

The N.Z. specimens call for further description. Two types occur which are clearly the megalospheric and microspheric types. The megalospheric type consists of two, or at most three, chambers of approximately equal diameter. The microspheric form runs to five, or more, chambers with a regular tapering. All

the individuals are constructed of large angular sand-grains, cemented with ferruginous cement, and usually so embedded as to present a relatively smooth contour, although in many specimens single isolated grains of larger size than usual project. The aperture is situated at the end of a produced neck constructed of very fine sand-grains with a maximum of cement, but owing to its fragility is often wanting, though its traces can always be found upon examination. There can be no doubt that Pearcey's *Reophax robustus* is referable to this species (P. 1914, SNA, p. 1006, pl. i, figs. 6–10), indeed, his figures represent the megalospheric and microspheric forms, and the produced neck, perfectly. It appears not improbable that Cushman's *R. advena* represents a closely-allied species, described from specimens in which the produced neck is lacking.

AMMODISCUS, Reuss.

154. *Ammodiscus incertus* (d'Orbigny).

Operculina incerta, d'Orbigny, 1839, FC. p. 49, pl. vi, figs. 16, 17.
Ammodiscus incertus, Cushman, 1910, etc., FNP. 1910, p. 73, fig. 95.

Stations 2, 6, 7, 26–29, 33, 40, 41, 47, 53, 55 (+ D.).

All the specimens are small except at Station 2 (N.Z.), where they are gigantic. Attached specimens at Station 6. At Station 29 the species is common and characterized by extremely neat, many-coiled individuals built with a maximum of cement. At Station 53, the largest Antarctic individual represents the species and is abnormal in the presence of a wild outgrowth on the last convolution.

[Porcellanous isomorph *Cornuspira involvens*, Rss.; Hyaline isomorph, *Spirillina vivipara*, Ehbg., closely-coiled forms. *Cf. Spirillina arenacea* in W. 1858, RFGB. p. 93.]

155. *Ammodiscus tenuis*, Brady.

Ammodiscus tenuis, Brady, 1879, etc., RRC. 1881, p. 51; 1884, FC. p. 332, pl. xxxviii, figs. 4–6.
,, *incertus* (pars), Cushman, 1910, etc., FNP. 1910, p. 75, fig. 96.

Stations 2, 5, 6, 29.

A few specimens only. The best N.Z. individuals, very large, at Station 6. One Antarctic specimen at Station 29.

[Porcellanous isomorph, *Cornuspira foliacea* (Phil.). Hyaline isomorph, *Spirillina vivipara*, Ehbg., evolute forms.]

156. *Ammodiscus mestayeri*, Cushman.

Ammodiscus mestayeri, Cushman, 1919, RFNZ. p. 597, pl. lxxiv, figs. 1, 2.

Stations 2, 5, 6.

As noted by Cushman, this form appears to be confined to the N.Z. area. It attains a very large size at Stations 2, 5, 6, especially at the last. Both the

megalospheric and microspheric forms occur. The test is constructed of coarser sand-grains than are usually employed by the genus, but its chief distinction lies in the fairly uniform diameter of the tube and its roughly circular outline, as contrasted with the compressed section of *A. tenuis*.

157. *Ammodiscus gordialis* (Jones and Parker).

Trochammina squamata gordialis, Jones and Parker, 1860, RFM. p. 304.
Ammodiscus gordialis, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 618, pl. xlvi, fig. 26.

Stations 2, 4, 6, 18, 22, 26, 27, 29, 38, 40, 45–48, 50, 54, 55 (+ K. I., D.).

More generally distributed in the Antarctic than in the N.Z. area. The best N.Z. Station was Station 6, where it occurs both free and attached. The best Antarctic Station was No. 26, where it is very common, large, free and attached. Sessile individuals were observed at Station 46 (growing on a living Pycnogonid), and at Station 55. At Stations 18 and 22 (single specimens) the test was smoothly constructed with a maximum of cement, an unusual characteristic in this species. At Station 29 a specimen occurred presenting all the characteristics of Döderlein's *Psammonyx vulcanicus* (Döderlein, 1892, Verh. Deutsch. geol. Ges. p. 145. See R. 1903, ZRR. p. 279, fig. 127 *a*, *b*), but the size is that of the normal *A. gordialis*, and does not reach the gigantic proportions recorded by Rhumbler from Japan.

158. *Ammodiscus charoides* (Jones and Parker).

Trochammina squamata charoides, Jones and Parker, 1860, RFM. p. 304.
Ammodiscus charoides, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 618.

Stations 16, 18, 20–23, 27 29, 32, 35, 36, 40, 42 (+ T. d. F.).

Exclusively confined to the Antarctic, and almost exclusively to the deepest water Stations. The best development at Station 22. Occasional large and well-developed specimens at other Stations, but on the average the individuals are much smaller than usual. This is particularly noticeable at Station 40, where the species was very common, and to a less extent at Station 29.

[Porcellanous isomorph *Cornuspira charoides*, H.-A. & E. 1914, etc., FKA. 1915, p. 593, pl. xlvi, fig. 15.]

159. *Ammodiscus shoneanus* (Siddall). Plate I, fig. 22.

Trochammina shoneana, Siddall, 1878, FRD. p. 46, figs. 1, 2.
Ammodiscus megaspira, Berthelin, 1878, FBP. p. 223 (p. 23 in reprint).
Turritella shoneana, Cushman, 1910, etc., FNP. 1910, p. 79, figs. 107–109.

Stations 2, 26, 27, 29, 38, 40, 48, 55.

A single specimen, typical, from the N.Z. area. The Antarctic records are few in number and the specimens rare, but they are, generally speaking, exceptionally well developed, particularly at Station 48. The Antarctic specimens are

more coarsely constructed and with a smaller proportion of cement than is usually the case.

It may be observed (*at supra*) that in the same year 1878—that Siddall published this species it was very accurately described, but without a figure, by Berthelin, under the name *A. megaspira*. But in 1858 Terquem described and figured under the name *Terebralina regularis* an organism which unquestionably bears a striking resemblance to Siddall's form (T., 1858, etc., FLM. 1866 (pt. vi), p. 473, pl. xix, fig. 3). He describes his species "Coquille regulière, droite, à spire turriculée, formée de 7 tours, sensiblement égaux." As regards the rival claims of Siddall and Berthelin we give the preference to the former, his description being accompanied by a figure, and his name universally adopted by later writers. In the absence of any reference to the nature of the shell-wall by Terquem, his name, which would otherwise have considerable priority, should, we think, be disregarded.

TROCHAMMINA. Parker and Jones.

160. *Trochammina squamata*, Jones and Parker.

Trochammina squamata, Jones and Parker, 1860, RFM. p. 304, and Table.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 619.

Stations 1, 5, 6, 13, 26, 27, 31, 33, 35, 38, 40, 43, 45, 46, 48, 49, 52, 53–55 (+ T. d. F., R. d. J.).

Very generally distributed, the finest and longest series of specimens at Station 6 in the N.Z. area. Both free, and (rarely) sessile. The sessile specimens exhibit extrusions of white cement, as is the habit in *Valvulina fusca* (Will.) Very common at many of the Antarctic Stations, notably so at Station 53. Stations 27, 38 and 46 also yielded good series of tests. At Station 48 a specimen was found in which the inferior umbilical recess was filled with a mass of light-coloured cement, showing, however, no indication of any polythalamous development. This may represent the accumulation of material preparatory to the formation of a budding-off individual. At many of the Stations there is practically an imperceptible passage through this form to *T. rotaliformis*.

[Hyaline isomorph, *Discorbina vilardeboana* (d'Orb.) (?), and *Valvulina fusca* (Will.).]

161. *Trochammina ochracea* (Williamson).

Rotalina ochracea, Williamson, 1858, RFGB. p. 55, pl. iv, fig. 112, pl. v, fig. 113.
Trochammina ochracea, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 619, pl. xlvi, figs. 27, 28.

Stations 2, 5, 6, 7, 27, 29, 40, 41, 44–47, 50, 52, 47 (+ D.).

Common at many Stations, well developed at Stations 27 and 41. At Stations 2 and 6 it occurs in two forms, (*a*) the normal, and (*b*) the widely keeled variety,

which we figured from Kerimba (*ut supra*). As one gets further south the specimens increase in numbers and size. Very fine at Station 50. At Station 46 the only sessile specimen found was attached to a living Pycnogonid.

162. *Trochammina plicata* (Terquem).

Patellina plicata, Terquem, 1875, etc., APD. 1876, p. 72, pl. viii, fig. 9.
Trochammina plicata, Heron-Allen and Earland, 1914, etc., FKA, 1915, p. 619.

Station 8.

One extremely pauperate individual.

163. *Trochammina inflata* (Montagu).

Nautilus inflatus, Montagu, 1808, TB. Suppl. p. 81, pl. xviii, fig. 3.
Trochammina inflata, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 620.

Stations 6, 16, 18, 29, 36, 40 (+ D.).

Neither numerous nor typical, but the best at Stations 6 and 40. Good specimens also at Station 16.

[Hyaline isomorph, *Discorbina rugosa* (d'Orb.).]

164. *Trochammina nitida*, Brady.

Trochammina nitida, Brady, 1879, etc., RRC. 1881, p. 52; 1884, FC. p. 339, pl. xli, figs. 5, 6.
" " Heron-Allen and Earland, 1914, etc., FKA, 1915, p. 620.

Stations 2, 6, 8, 9, 33.

A few excellent specimens at Stations 2 and 6. Very small at Stations 8 and 9.

165. *Trochammina moniliformis*, sp. nov. Pl. III, figs. 18-23.

Station 6.

Test free, finely arenaceous, consisting of a number of swollen chambers loosely coiled in an elliptical spiral, and communicating with one another by a broad neck more than half the width of the individual chambers. Aperture large, circular, situated at the end of the tapering extremity of the chamber.

This species, based upon one or two perfect specimens and a number of fragments, probably represents one of the simplest of the Arenaceous Foraminifera. Its nearest congener would appear to be *T. proteus*, Karrer, or something between that form and the pauperate *T. coronata*, Brady. In the largest specimen which we figure it will be seen that the arrangement of the chambers is a very primitive spiral with gaps wherever the two adjacent chambers do not fit into one another. The septation is of the most primitive character, being merely strictures at intervals in what would otherwise have been merely a broad thin-walled tube. Even this rudimentary septation is not always present, for among the fragments which are unquestionably referable to this organism, is one, which we figure, exhibiting no trace of segmentation. In other specimens the chambers are more or less irregularly heaped together, although a spiral arrangement of

a rudimentary kind may still be traced, as though a bead-necklace had been dropped in an irregular heap.

The wall is constructed of the very finest mud, deeply stained with ferruginous cement, matt on the exterior surface, but smooth and polished within. The size is very variable; perfect individuals range between ·3–·6 mm. maximum diameter. Fragments only of many larger specimens. Chambers, width of tube and aperture also vary greatly in size. Some fragmentary chambers reach ·3 mm. in diameter.

166. *Trochammina uviformis*, Grzybowski. Pl. III, figs 16, 17.

Trochammina uviformis, Grzybowski, 1901, OWI. p. 65, pl. viii, figs. 1, 2. Abstract (in German) pp. 221–226 (same pl. and figs.).

Station 6.

Test free, consisting of a number of oval chambers built up of very fine sand and ferruginous cement, irregularly agglomerated, communicating by a simple aperture between successive chambers. The earliest chambers in the series are more or less spirally arranged, the later chambers show no signs of co-ordinated plan. Size variable, ranging between ·44 mm. and 1 mm. in diameter of specimens.

A few individuals only, which we have referred to Grzybowski's species, occur at this Station. They agree more or less with his figures of this species, and of his *T. mitrata* (*loc. cit.*, fig. 3), which appears to be identical, but owing to the fact that the description is written in Polish, no precise confirmation can be derived by us from his text. It would appear, however, that he compares his species in some respects with *T. coronata*, Brady. Such specimens may be regarded as arenaceous isomorphs of *Gypsina inhaerens*. The specimen Fig. 7, attributed by Karrer (K., 1865, FWS. p. 294, pl. 0, fig. 7) to *T. proteus*, apparently represents the form subsequently described by Grzybowski (*ut supra*) it differs considerably from all Karrer's other figures of the variable type *T. proteus*. At the same Station several specimens which are zoologically identical, but present certain differences. Instead of the regularly-shaped oval chambers, and the compact agglomeration, the chambers are irregular in shape, size and arrangement, and heaped together without any regular plan. They represent the wildest development of *Gypsina inhaerens*, in an arenaceous form.

167. *Trochammina trullissata*, Brady.

Trochammina trullissata, Brady, 1879, etc., RRC. 1879, p. 56, pl. v, figs. 10 *a*, *b*, 11; 1884, FC. p. 342, pl. xl, figs. 13–16.
Haplophragmium ,, Cushman, 1910, etc., FNP, 1910, p. 100, fig. 148.

Stations 6, 11, 13, 25, 27, 29, 32, 41, 44 (+ D).

Never more than a single specimen. A considerable range in colour, from deep ochraceous to almost white. A very large (broken) specimen at Station 25.

168. *Trochammina ringens*, Brady.

Trochammina ringens, Brady, 1879, etc., RRC, 1879, p. 57, pl. v. figs. 12 *a*, *b*; 1884, FC. p. 343, pl. xl, figs. 17, 18.
" " Millett, 1898, etc., FM. 1899, p. 365, pl. v, fig. 14.

Station 6.

Two very fine examples.

169. *Trochammina pauciloculata*, Brady.

Trochammina pauciloculata, Brady, 1879, etc., RRC. 1879, p. 58, pl. v, figs. 13, 14; 1884, FC. p. 344, pl. xli, figs. 1, 2.
Ammochilostoma " Cushman, 1910, etc., FNP. 1910, p. 126, figs. 197.

Stations 7, 8, 10, 11, 29, 32, 35, 40, 55.

Most frequent and best at Station 10. At Station 29 specimens were of a curiously elongate narrow-chambered form, evidently pauperate.

170. *Trochammina galeata*, Brady.

Trochammina galeata, Brady, 1879, etc., RRC. 1881, p. 52; 1884, FC. p. 344, pl. xl, figs. 19–23.
" " Cushman, 1910, etc., FNP. 1910, p. 127, figs. 198–201.

Stations 29, 40.

One unquestionable, and two not so satisfactory, examples at these Stations.

171. *Trochammina robertsoni*, Brady.

Trochammina robertsoni, Brady, 1876, CPF. p. 80, pl. iii, figs. 6, 7.
" " Wright, 1891, SWI. p. 469, pl. xx, figs. 4, *a*, *b*.
" " Goës, 1894, ASF. p. 30, pl. vi, figs. 231–234.

Stations 13, 29, 34, 35.

The specimens, though few in number, present considerable variation. At Station 29 they are very large and the shell has not the smooth finish due to excessive cement which usually marks the species. At Station 34 a single very thin-walled and pauperate individual; at Station 35 it was quite typical.

172. *Trochammina rotaliformis*, Wright.

Trochammina inflata (Montagu), var., Balkwill and Wright, 1885, DIS. p. 331, pl. xiii, figs. 11, 12.
" *rotaliformis*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 620.

Stations 2, 4, 6–8, 10, 11, 13, 15, 16, 25, 27, 29, 31, 33, 35, 38, 40, 42–44, 46–50, 52 55 (+ T. d. F., D.).

Almost universally distributed and extremely common in the Antarctic area, especially at Stations 38 and 54. Besides the usual range of specimens running back towards *T. squamata*, a few specimens are to be met with at most Stations where it is abundant, ranging towards *T. vesicularis*, Goës (G. 1894, ASF. p. 31, pl. vi, figs. 235–237), which has more whorls, and more segments to the whorl, and generally speaking a more pronounced rotalian contour than Wright's

original species, but is hardly worth separation. At Station 6 a sessile individual, embedded in white cement, was observed.

[Hyaline isomorph, *Discorbina globularis* (d'Orb.).]

WEBBINA, d'Orbigny.

173. *Webbina clavata* (Jones and Parker).

Trochammina irregularis clavata, Jones and Parker, 1860, RFM. p. 304.
Webbina (*Ammolagena*) *clavata*, Cushman, 1910, etc., FNP. 1910, p. 68, figs. 86 89.

Stations 6, 16, 23, 25, 29, 36, 39 (+ T. d. F.).

Sparingly represented at all the Stations and presenting no special features excepting at Station 6 (N.Z.). Here the type occurs, but less abundantly than the moniliform variety originally described by d'Orbigny from a figure of Cornuel's as *Webbina irregularis* (q.v. *post*). The difference in the shape of the chambers makes it worth while recording this as a separate form, though there can be little doubt as to the zoological identity of the specimens.

174. *Webbina irregularis*, d'Orbigny. Pl. III, fig. 24.

Oeufs d'autres Mollusques, Cornuel, 1848, NFM, p. 259, pl. iv, fig. 37.
Webbina irregularis, d'Orbigny, 1850, etc., PP. vol. ii, p. 111, No. 783.
" *laevigata*, Costa, 1853, etc., PRN. 1856, 187, pl. xvi, fig. 14

Station 6.

Attached to stones and differing from *W. clavata* in the smaller size of the chambers, their pyriform shape, and the arrangement in a continuous chain of three or more segments, often variable in shape, adapting themselves to the contour of the host. Constructed like *W. clavata*, of fine sand with a maximum of reddish cement, colour varying as in that species, from pale yellowish-grey to deep brown.

It is extremely interesting to find this form, hitherto exclusively known as a fossil, from the Lias upwards, in the recent condition. The N.Z. specimens differ from Cornuel's original figure, and subsequent figures, in the length of the stolon-tubes between the successive chambers. In some instances the stolon is as long as the chamber itself. The nearest approach perhaps, is the specimen figured by Costa, *ut supra*.

Sub-Family LOFTUSINAE.

CYCLAMMINA, Brady.

175. *Cyclammina pusilla*, Brady.

Cyclammina pusilla, Brady, 1879, etc., RRC. 1881, p. 53; 1884, FC. p. 353, pl. xxxvii, figs. 20 23.
" " Cushman, 1910, etc., FNP. 1910, p. 111, fig. 172.

Stations 13, 19, 20, 21, 22, 23, 24, 25, 28, 32, 33 36, 39, 40, 42.

This is perhaps the most typical Foraminifer of all the deep-water Stations

between the N.Z. area and the Antarctic coast-line, extending between Stations 13 and 42, which latter is the most southerly record. The finest series at Station 40. Other good examples at Stations 32, 33, 34. At Station 39 all the individuals were notably small.

176. *Cyclammina cancellata*, Brady.

Cyclammina cancellata, Brady, 1879, etc., RRC. 1879, p. 62 (*Nautiloid lituela*); 1884, FC. p. 351, pl. xxxvii, figs. 8–16.
" " Cushman, 1910, etc., FNP. 1910, p. 110, figs. 168–171.

Stations 18, 23, 29 (+ D.).

A single imperfect but undoubted specimen at Station 18, small ones at Stations 23 and 29.

177. *Cyclammina orbicularis*, Brady.

Cyclammina orbicularis, Brady, 1879, etc., RRC. 1881, p. 53; 1884, FC. p. 353, pl. xxxvii, figs. 17–19.
" " Cushman, 1910, etc., FNP. 1910, p. 113, fig. 173.

Stations 8, 16, 23, 29, 32, 35.

One large and typical specimen from Station 8. Similar specimens from Stations 23, 29, and 32. A doubtful specimen from Station 35.

FAMILY TEXTULARIIDAE.

SUB-FAMILY TEXTULARIINAE.

TEXTULARIA, Defrance.

178. *Textularia inconspicua*, Brady.

Textularia inconspicua, Brady, 1884, FC. p. 357, pl. xlii, fig. 6.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 623, pl. xlvii, figs. 1–4.

Stations 2, 3, 5, 6 (+ R. d. J.).

Very fine and typical specimens attaining considerable size at Stations 5 and 6. All the examples are much nearer to Brady's figure than to Millett's, and they are all characterized by thick bands of clear shell-substance, marking the sutural lines and originating in a thick striated ring, which forms the basal outline of the successive chambers, as shown in Brady's fig. 6 *b*. This thick band gives an appearance of limbation, but when seen in side view none of the specimens are truly limbate, and thus referable to the var. *jugosa*.

Cushman (C. 1919, RFNZ. p. 626) refers this form to the Rotaliidae, under the name of *Discorbis inconspicua*, Brady, referring to Millett and Brady and his own previous remarks (C. 1910, etc., FNP. 1911, p. 11). He states that from six N.Z. specimens he has been able to determine definitely that the form should be placed among the Rotaliidae, "in some of its markings it resembles *Patellina*

. . . it seems to be a species in which the chambers each make a half-coil as added, and its resemblance to *Textularia* is only superficial." We are quite unable to agree with this. An examination of a very great number of specimens from many localities show that beyond an apical "multiformity" limited to the first three or four chambers, the shell is a true Textularian. The genus *Textularia* is particularly subject to multiformity in its early stages. In *T. inconspicua* the early growth appears to be the normal spiroplectine coil observable in most species, but set at a different angle to the subsequent axis of growth. Millett's specimens, which are now in our collection, and which are very numerous, give no support to Cushman's theory, and the "minute rotalian," to which Millett refers as occurring in association with *T. inconspicua*, does not appear on his slides, nor is it otherwise referred to in his papers among the Discorbinae. It appears probable, therefore, that in the intervening years between 1899 and 1903 he obtained no further evidence inducing him to alter his views in assigning the form to *Textularia*.

179. *Textularia concava* (Karrer).

Plecanium concavum, Karrer, 1868, MFKB. p. 129, pl. i, fig. 3.
Textularia concava, Heron-Allen and Earland, 1914, etc., FKA, 1915, p. 624.

Stations 2–6, 9.

Confined to the N.Z. area, the best at Stations 3 and 6, where it attains a large size and is very typical and neatly constructed. At the same Stations occasional specimens are strongly limbate. This variation appears to be the *T. crassisepta* of Cushman (C. 1910, etc., FNP. 1911, p. 24, fig. 41). At Station 6 intermediate forms linking Karrer's very well-marked type with the wildly growing var. *heterostoma* occur. At Station 9 the record stands on a single small individual with a hyaline shell.

180. *Textularia concava*, var. *heterostoma*, Fornasini.

Sagraina affinis, Fornasini, 1883, FPS. p. 189, pl. ii, fig. 10.
Textularia concava, var. *heterostoma*, Heron-Allen and Earland, 1916, FWS. p. 229, pl. xl, figs. 22, 23.

Stations 3, 4, 6, 8–11, 16, 18, 19, 22, 36 (+ T. d. F., D.).

The specimens from Stations 3, 4 and 6, especially the latter, are large and typical, exactly representing Fornasini's figures. They are linked up with the type by a few intermediate specimens. The individuals from the remaining Stations present a very different appearance, and, generally speaking, can only be relegated to Fornasini's variety by association with a long series of specimens. They are small, rough in surface-texture, and the aperture is often produced upon a phialine neck instead of being a prominent crescentiform slit. The figure of *Sagraina affinis*, Fornasini (*ut supra*) very well represents the prevalent type: this is the *T. catenata* of Cushman (C. 1910, etc. F.N.P. 1911, p. 23, figs. 39–40)

At Station 6 two extremely abnormal individuals, one, fossil, which we have described and figured elsewhere (H.-A. & E. 1920, VP. p. 161, pl. xvi, fig. 3). This is the *Globotextularia anceps* (Brady) of Eimer and Fickert (1899, Artbildung und Verwandtschaft, pp. 559 and 563, figs. 6 and 10; and Cushman, 1910, etc. FNP. 1910, p. 125, fig. 25). The other, to all appearance recent. The latter specimen is broken, but when perfect the oral extremity appears to have terminated in a series of large globular chambers irregularly disposed round the textularian aperture on the last normal chamber.

[Arenaceous isomorph of the abnormal form, *Haplophragmium anceps*, Brady.]

181. *Textularia sagittula*, Defrance.

Textularia sagittula, Defrance, 1824, Dict. Sci. Nat., vol. xxxii, p. 177; vol. liii. p. 344; Atlas Conch. pl. xiii, fig. 5.
.. .. Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 625.

and

Spiroplecta wrightii, Silvestri.

Spiroplecta sagittula (Defrance), Wright, 1891, SWI. p. 471.
.. .. Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 634.

Stations 2, 3, 5, 6.

These two forms occur, as usual, in company, and we have less hesitation than ever as to their specific identity. Both are characterized whenever they occur by fistulose development. The best range occurs at Station 6, where *T. sagittula* attains a very fine development in pectinate forms such as *T. mariae*, d'Orb. (d'O., 1846, FFV. p. 246, pl. xiv, figs. 29 31), and *T. pectinata*, Reuss (R., 1849–50, FOT. p. 381, pl. xlix, figs. 2, 3). In a few instances the pectination is even more strongly developed than in either of these forms, developing into pronounced fistulose tubules. These individuals are, perhaps, racially distinct from *T. sagittula*, as no spiroplectine individuals having the glistening, smoothly agglutinated, external shell-layer, which characterizes the pectinate individuals were observed. The typical *T. sagittula* and the typical *S. wrightii* have a characteristically matt surface.

181A. *Textularia milletti*, Cushman.

Textularia milletti, Cushman, 1910, etc., FNP. 1911, p. 13, figs. 18, 19.

Station 11.

Very rare but typical. They resemble Cushman's figures much more closely than the figure of Millett of *T. sagittula*, var. *jugosa*, T. R. Jones (M., 1898, etc., FM. 1899, p. 561, pl. vii, fig. 8), on which Cushman's new specific name is founded.

182. *Textularia rugosa* (Reuss).

Plecanium rugosum, Reuss, 1869, FOG. p. 453, pl. i, fig. 3.
Textularia rugosa, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 625, pl. xlvii, figs. 7–9.

Stations 2, 6.

Frequent at Station 2, where it attains considerable development, including fistulosity in a minor degree. Many specimens have obviously grown attached to Zoophytes.

183. *Textularia agglutinans*, d'Orbigny.

Textularia agglutinans, d'Orbigny, 1839, FC. p. 144, pl. i, figs. 17, 18, 32–34.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 626.

Stations 1–4, 6, 8.

Abundant and variable. At most of the Stations there is a marked tendency to limbation, running the specimens into *T. rugosa*. At Station 6, in addition to the type and rugose forms, there is a smooth-walled variety running imperceptibly into the swollen chambered *T. candeiana*. At Station 2, an abnormal specimen in which the last four chambers were set with the axis at right angles to the earlier growth. At Station 6 individuals living attached to Polyzoa, similar to the *T. sagittula* recorded by us from the West of Scotland (H.-A. & E., 1916. FWS. p. 229.)

184. *Textularia candeiana*, d'Orbigny.

Textularia candeiana, d'Orbigny, 1839, FC. p. 143, pl. i, figs. 25–27.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 627, pl. xlvii, figs. 10–16.

Stations 6, 11.

A few remarkably fine and typical specimens from Station 6 characterized by the thinness and even texture of the finely agglutinated walls. One small specimen from Station 11.

185. *Textularia porrecta*, Brady. Pl. IV, figs. 6, 7.

Textularia agglutinans, var. *porrecta*, Brady, 1884, FC. p. 364, pl. xliii, fig. 1.
,, *porrecta*, Egger, 1893, FG. p. 269, pl. vi, figs. 17, 18.
,, *sagittula*, var. *fistulosa*, Brady, 1884, FC. p. 362, pl. xlii, fig. 19 (only).
Spiroplecta sagittula, and var. *fistulosa*, Chapman, 1905, GBI. p. 87, pl. iii, fig. 4.
,, *siphonifera*, Chapman, 1909–10, SBL. p. 272, pl. iii, fig. 1.
Textularia stricta, Cushman, 1910, etc., FNP. 1911, p. 11, fig. 13.
Textularioides inflata, Cushman, *ibid.*, p. 26, fig. 45.

Stations 2, 6.

Frequent only at Stations 2 and 6, but well known to us from many dredgings in adjacent areas. It is a large and striking Textularian characterized by several features rarely seen in other forms. So far as we have been able to trace, all the specimens are spiroplectine in the early stages, but this is rapidly followed by a long series of chambers, wedge-shaped at first, in the manner of *T. sagittula*, but rapidly becoming inflated, so that the terminal portion of the shell is almost circular in cross-section. The number of chambers in the finest specimens reaches as many as twenty pairs.

The test is coarsely constructed of sand-grains, the whole plastered over with

a fine superficial layer of cement composed of the finest mud, and apparently highly perforate. This thin superficial layer is, in nearly all instances, produced out at the edge into fistulose extensions. In the most typical examples this fistulosity extends the entire length of the shell; in others it is confined to the initial half. In a few instances it extends backwards from the fistulose tubes as a ridge along the middle of each chamber towards the median line, and when broken away leaves a very characteristic scar across the chamber, hardly distinguishable from the limbation of *T. rugosa*, though due to quite another cause.

These N.Z. specimens appear to link up two widely differentiated species, *T. sagittula* and *T. agglutinans*. In their compressed cuneiform outline, spiroplectine initial chambers, and fistulosity, they closely indicate a relationship to *T. sagittula*, Defr., whereas the inflated later chambers and the oval, or nearly circular, cross-section of the later plan are characteristic of *T. agglutinans*. Brady's Fig. 19, *T. sagittula*, var. *fistulosa*, differs from the other three figures in the swollen character of the later chambers and probably represents the N.Z. form. Chapman, in his Batesford Limestone paper, assigns Brady's form to *Spiroplecta*, and, in his Barrier Island paper, describes both the plain and the fistulose types under *S. sagittula*. We have already published our views on this question of the separation of the spiroplectine forms (H.-A. & E., 1913, CI, p. 57). Cushman's *T. stricta* appears without question to be the same as our form. No mention is made by him of the nature of the initial chambers, but the rounded extremity of his figure strongly suggests a spiroplectine beginning. Under the name *Textularioides inflata* (gen. nov., sp. nov.) he figures a single attached specimen which appears to be inseparable from this form. Incidentally it may be noted that at both the "Terra Nova" Stations specimens occur which have been attached to Polyzoa, and sessile individuals are recorded in many species of *Textularia*.

186. *Textularia fungiformis*, Fornasini.

Textularia fungiformis, Fornasini, 1887, ITI. p. 396, pl. x, figs. 1, 1 *a*, *b*: 1896, TC. p. 2, *et seq.* pl. 0, figs. 1–5.

Stations 1, 3.

The tendency to variation by expansion of the later-formed chambers in *T. agglutinans* reaches its extreme development at Stations 1 and 3, resulting in typical specimens of this species.

187. *Textularia abbreviata*, d'Orbigny.

Textularia abbreviata, d'Orbigny, 1846, FFV. p. 249, pl. xv, figs. 7 (not 9)–12.
" " Cushman, 1910, etc., FNP, 1911, p. 14, fig. 20.

Station 6.

A few good specimens at this single Station.

188. *Textularia gramen*, d'Orbigny.

Textularia gramen, d'Orbigny, 1846, FFV. p. 248, pl. xv, figs. 4–6.
„ „ Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 627.

Stations 2–7 (+ R. d. J.).

Frequent and very variable, running through abnormal specimens into *T. conica*, *agglutinans*, and *abbreviata*. At several Stations specimens showing marked limbation, and in a few instances rudimentary fistulosity. Most variable at Station 6.

189. *Textularia conica*, d'Orbigny.

Textularia conica, d'Orbigny, 1839, FC. p. 143, pl. i, figs. 19, 20.
„ „ Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 629.

Stations 1–3, 6 (+ R. d. J.).

Typical specimens, fairly abundant at Station 6.

190. *Textularia conica*, var. *horrida*, Egger. Pl. IV, figs. 3, 4.

Textularia horrida, Egger, 1893, FG. p. 270, pl. vi, figs. 11, 12.
„ „ Cushman, 1910, etc., FNP. 1911, p. 10, fig. 12.

Stations 1–3, 6.

Strongly fistulose specimens occur in company with the type, *T. conica*, at the N.Z. Stations. Their nearest congener is *T. horrida*, Egger, but the N.Z. specimens are much more neatly and regularly fistulose than is indicated by either Egger's or Cushman's figures. Many of the specimens show limbation somewhat similar to our variety *corrugata* (H.-A. & E., 1914, etc., FKA., 1915, p. 629, pl. xlvii, figs. 24–27), which is very probably a passage-form between the smooth edged type *T. conica* and its fistulose form, var. *horrida*. Size varies between ·30–·50 mm. in length and ·40–·55 mm. in breadth.

191. *Textularia trochus*, d'Orbigny.

Textularia trochus, d'Orbigny, 1840, CBP. p. 45, pl. iv, figs. 25, 26.
„ „ Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 630, pl. xlvii, fig. 28.

Stations 1–3, 6.

Rare except at Station 6, very fine specimens there, and at Station 2. One sessile specimen at Station 6.

SPIROPLECTA, Ehrenberg.

192. *Spiroplecta annectens* (Parker and Jones).

Textularia annectens, Parker and Jones, etc., 1859, etc., NF. No. 8, 1863, p. 92, fig. 1.
Spiroplecta „ Millett, 1898, etc., FM. 1900, p. 8, pl. i, fig. 7.

Stations 6, 29, 33.

One megalospheric individual from Station 6, closely resembling Millett's figure, and two small microspheric at the Antarctic Stations, very long and narrow.

193. *Spiroplecta biformis* (Parker and Jones).

Textularia agglutinans, var. *biformis*, Parker and Jones, 1865, NAAF. p. 370, pl. xv, figs. 23, 24.
Spiroplecta biformis, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 634.

Stations 9, 17, 40 (+ T. d. F.).

One specimen at Station 9, a few of the long type at Station 17, and common at Station 40, where all the specimens were of a small and rather coarsely constructed variety.

GAUDRYINA, d'Orbigny.

194. *Gaudryina pupoides*, d'Orbigny.

Gaudryina pupoides, d'Orbigny, 1840, CBP. p. 44, pl. iv, figs. 22–24.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 634.

Stations 6, 7, 10, 12.

Few in number, the best at Station 7.

195. *Gaudryina subrotundata*, Schwager.

Gaudryina subrotundata, Schwager, 1866, FKN. p. 198, pl. iv, figs. 9 *a–c*.
" " Brady, 1884, FC. p. 380, pl. xlvi, figs. 13 *a–c*.
" " Flint, 1899, RFA. p. 287, pl. xxxiii, fig. 1.

Stations 6, 10, 16.

Very rare and poorly developed, except at Station 6, where a few very large individuals were found.

196. *Gaudryina filiformis*, Berthelin.

Gaudryina filiformis, Berthelin, 1880, EAM. p. 25, pl. xxiv, fig. 8.
" " Heron-Allen and Earland, 1913, CI. p. 57, pl. iv, figs. 7–9; 1914, etc., FKA. 1915, p. 634.

Stations 10, 11, 13, 27–29, 31, 32, 38, 40, 48, 52, 55 (+ D.).

Almost confined to the Antarctic area. All the specimens are of the minute, many-chambered type commonly found round the Scotch and Irish Coasts. The best at Stations 27, 28, and 29. At the more southerly Stations the individuals do not attain such fine development. We see no reason for modifying Brady's acceptance of Berthelin's species for the recent forms.

197. *Gaudryina rugosa*, d'Orbigny. Pl. IV, figs. 16, 17.

Gaudryina rugosa, d'Orbigny, 1840, CBP. p. 44, pl. iv, figs. 20, 21.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 635.

Stations 1–6.

Confined to the N.Z. area, where it attains fine development, notably at Station 2. At all the Stations it occurs in two distinct forms, the type repre-

sented by (*a*) short, comparatively few-chambered, stoutly-built individuals, and (*b*) a very long, narrow, sharply angular type, ranging up to 1·10 mm. in length, characterized by an abnormally large number of gaudryine (triserial) chambers. The two may possibly represent the megalo- and micro-spheric conditions. The short form is found living sessile upon Polyzoa at Station 6.

198. *Gaudryina scabra*, Brady.

Gaudryina pupoides, Brady, 1870, FTR. p. 300, pl. xii, fig. 5.
,, *scabra*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 635, pl. xlviii, figs. 7–11.

Station 23.

One typical specimen.

199. *Gaudryina siphonella*, Reuss.

Gaudryina siphonella, Reuss, 1851, FSUB. p. 78, pl. v, figs. 40-42.
,, ,, Brady, 1884, FC. p. 382, pl. xlvi, figs. 17–19.
,, ,, Sidebottom, 1918, FECA. p. 23, pl. ii, figs. 24, 25.

Stations 7, 13, 18.

A few typical specimens at Station 7, a sounding for which no depth is given, and one typical example from Station 13 (3,603 fms.).

200. *Gaudryina ferruginea*, sp. nov. Pl. IV, figs. 13–15.

Station 6.

Test free, multiform, the earlier portion consisting of closely-adherent triserial chambers about seven in number, followed by two or three pairs of compressed biserial chambers, with angular edges, the compressed portion sometimes having a lateral twist. Constructed of large, flat sand-grains and ferruginous cement, very dark brown at the initial portion of the shell, becoming brighter in colour at the oral extremity. Septation very obscure, especially in the earlier chambers. Aperture, a normal loop on the inner face of the terminal chamber.

Dimensions:—Length, ·30–·40 mm.; breadth, ·20 mm.

This distinctive little form is confined to Station 6, where a fair number of specimens were observed. It cannot easily be mistaken for any other species, but apparently belongs to the same group as *G. wrightiana*, Millett (M. 1898, etc., FM. 1900, p. 10, pl. i, figs 11, 12) *G. jonesiana*, Wright (W. 1885 6, KH. p. 329, pl. xxvii, figs 1, 2) and *G. pariana*, Guppy (G. 1894, FMDT. p. 651, pl. xli, figs. 21, 22). Characterized by the small initial triserial development, and the compressed biserial subsequent chambers. It bears some superficial resemblance in the colour and rough construction of the shell to *Verneuilina polystropha* (Reuss), but is readily distinguished by the compressed biserial chambers. The colour is very distinctive.

VERNEUILINA, d'Orbigny.

201. *Verneuilina spinulosa*, Reuss.

Verneuilina spinulosa, Reuss, 1849–50, FOT. p. 374, pl. ii (xlvii), fig. 12.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 630

Station 2.

A single spineless individual.

202. *Verneuilina triquetra* (Münster).

Textularia triquetra, Roemer, 1838, CNTM. p. 384, pl. iii, fig. 19.
Verneuilina " Brady, 1884, FC. p. 383, pl. xlvii, figs. 18–20.
" " Millett, 1898, etc., FM. 1900, p. 10.

Stations 1–6.

Common at some Stations in the N.Z. area, the specimens as a rule small, excepting at Station 6.

203. *Verneuilina turris*, sp. nov. Pl. IV, figs 8–12.

Stations 3, 4, 5, 6 (+ R. d. J.).

Test free, consisting of a triserial arrangement of chambers forming a cylinder with a bluntly conical apex, and an abruptly truncate base, containing the aperture, which is a verneuiline loop on the inner edge of the final chamber. Surface coarsely punctate. Sutural lines, thick, sometimes limbate, not perforate on the sutural lines. Usually pale brown in colour at the apex and becoming colourless in the later chambers.

Size :—Length, ·15–·25 mm. ; breadth, ·12–·15 mm.

Common at Station 6, and less frequent at Stations 3 and 5.

We have long been familiar with this little form, which occurs in many shallow-water gatherings from N.Z. The plan of the arrangement of the early chambers is very difficult to determine, but it appears to be spiral, as in the initial chambers of *Textularia inconspicua* (*q.v.*), but the triserial arrangement is immediately assumed, and retained during the remainder of the life of the animal and the whole aspect of the shell is distinctively verneuiline.

204. *Verneuilina polystropha* (Reuss).

Bulimina polystropha, Reuss, 1845 6, VBK. pl. ii, p. 109, pl. xxiv, fig. 53.
Verneuilina " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 631 ; 1920, VP. (*passim*), pl. xvi–xviii.

Stations 7, 29 (+ D.).

Extremely rare.

205. *Verneuilina pusilla*, Goës.

Verneuilina pygmaea, Goës, 1894 ASF. p. 33, pl. vii, figs. 262–3.
,, *pusilla*, Goës, 1896, DOA. p. 39, pl. v, figs. 6–8.
,, *polystropha*, Heron-Allen and Earland, 1913, CL. p. 55, pl. iv, figs. 3–5.
,, *pusilla*, Heron-Allen and Earland, 1920, VP. (*passim*) pl. xvi, fig. 11, pl. xvii, figs. 12, 13.

Stations 27, 29, 52, 55.

Confined to the Antarctic. Rare, but very typical, the best at "Farthest South" (Station 55), both megalo- and micro-spheric.

206. *Verneuilina pygmaea* (Egger).

Bulimina pygmaea, Egger, 1857, MSO. p. 284, pl. viii (xii), figs. 10, 11.
Verneuilina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 631.

Stations 7, 11, 12, 16, 18–20, 22, 25, 28, 32–36, 40, 55 (+ D.).

Occurs in both areas and in some numbers as far as Station 20, after which the records are of single specimens at the Stations down to Station 36, where it reappears plentifully. It then disappears until Station 55, where a single large specimen was found. There are two types, megalospheric, which is very short and few-chambered, and the microspheric, a larger, longer shell with many chambers. The two, as a rule, occur together where the species is abundant, but at Station 36, where it was plentiful, only the megalospheric type occurs.

207. *Verneuilina propinqua*, Brady.

Verneuilina propinqua, Brady, 1884, FC. p. 387, pl. xlvii, figs. 8–14.
,, ,, Burrows, Sherborn and Bailey, 1890, RC. p. 553, pl. viii, fig. 18 *a*, *b*.
,, ,, Grzybowski, 1901, OWI. p. 224, pl. ix, fig. 18.

Stations 16, 22, 40 (+ D.).

Except at Station 16, where several specimens, and many more fragments of what must have been very large specimens, were found, the species is very rare. It should, in our opinion, be recorded merely as an arenaceous variety of *V. pygmaea*.

VALVULINA, d'Orbigny.

208. *Valvulina fusca* (Williamson).

Rotalina fusca, Williamson, 1858, RFGB. p. 55, pl. v, figs. 114, 115.
Valvulina ,, Cushman, 1910, etc., FNP. 1911, p. 59, figs. 94, 95.

Station 6.

Both free and sessile individuals.

209. *Valvulina conica*, Parker and Jones.

Valvulina triangularis, Parker and Jones, 1857, FCN. p. 295, pl. xi, figs. 15, 16.
,, *conica*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 635.

Station 6.

A few examples both sessile and free.

CLAVULINA, d'Orbigny.

210. *Clavulina communis*, d'Orbigny.

Clavulina communis, d'Orbigny, 1826, TMC. p. 268, no. 4.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 636, pl. xlviii, figs. 15–17.

Stations 2, 3, 6, 7, 8, 10–12, 16–18, 22, 28, 33–35, 42.

A series of specimens of this species offer an interesting illustration of the influence of environment on external form. No tyro, confronted with specimens from Station 3 and any of the deep-water Stations to the south, would imagine that the same organism was responsible for both. In the shallow water of the N.Z. area as far as Station 6, where the sand is comparatively coarse, the animal constructs a stout, short cylindrical test, broad in proportion to its length. As the water deepens and the size of the mineral grains becomes smaller, the test becomes longer, narrower, smoother in construction, until in the deepest water Stations, where it occurs, the test is practically cylindrical without external sign of the clavuline initial chambers; perfectly smooth owing to the fineness of the constituent material, and only recognizable externally by the projecting tubular aperture. Some of these deep-water specimens attain a great size, unbroken specimens 4–5 mm. long were found at Stations 10 and 11, and at Station 16 fragments indicating specimens which must have been three times that size.

211. *Clavulina obscura*, Chaster.

Verneuilina polystropha (Reuss), "dimorphous form," Wright, 1885–6, BLP. p. 320, pl. xxvi, fig. 2.
Clavulina obscura, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 636.

Stations 6, 55.

A single specimen at each Station referable to this obscure species.

212. *Clavulina parisiensis*, d'Orbigny.

Clavulina parisiensis, d'Orbigny, 1826, TMC. p. 268, no. 3, Modèle no. 66.
" " Cushman, 1910, etc., FNP. 1911, p. 75, figs. 123, 124.

Station 53 (+ R. d. J.).

One very small but typical specimen. Its occurrence in such a southern latitude is noteworthy.

213. *Clavulina cylindrica*, Hantken.

Clavulina cylindrica, Hantken, 1875, CSS. p. 18, pl. i, fig. 8.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 636, pl. xlviii, figs. 18, 19.

Stations 3, 6, 10, 11 (+ R. d. J.).

Confined to the N.Z. area and reaching its maximum development at Station 6, where it occurs in every conceivable variety, from almost spherical to cylin-

drical with almost parallel sides. The method of construction varies equally widely, some of the specimens are smoothly, but loosely, constructed, sponge-spicules being largely employed, and have a rough-cast appearance. In others, although the constituent materials are very much larger, other Foraminifera affording favourite material, the interstices are so carefully plastered up with finer material and mud as to give an unbroken outline to the test. The aperture is usually at the end of a short produced neck with the clavuline tooth, but in many specimens is flush with the wall and difficult to distinguish.

Sub-Family BULIMININAE.

BULIMINA, d'Orbigny.

214. *Bulimina pupoides*, d'Orbigny.

Bulimina pupoides, d'Orbigny, 1846, FFV. p. 185, pl. xi, figs. 11, 12.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 637.

Stations 3, 6, 16, 24.

Fairly good specimens, but uncommon.

215. *Bulimina elegans*, d'Orbigny.

Bulimina elegans, d'Orbigny, 1826, TMC. p. 270, no. 10, Modèle no. 9.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 638.

Stations 3, 6, 29.

Neither common nor very typical. The best at Station 29.

216. *Bulimina elegans*, var. *exilis*, Brady.

Bulimina elegans, var. *exilis*, Brady, 1884, FC. p. 399, pl. l, figs. 5, 6.
,, ,, ,, ,, Heron-Allen and Earland, 1916, FWS. p. 234, pl. xli, figs. 4–9.

Station 7.

Fairly typical, but hardly as long as the type demands.

217. *Bulimina fusiformis*, Williamson.

Bulimina pupoides, var. *fusiformis*, Williamson, 1858, RFGB. p. 63, pl. v, figs. 129, 130.
,, *fusiformis*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 638.

Stations 3, 7–9, 16, 27, 36.

Excellent specimens at Stations 7, 8, 16 and at Station 27, but curiously rare considering the abundance with which this species generally occurs where it is found at all.

218. *Bulimina pyrula*, d'Orbigny.

Bulimina pyrula, d'Orbigny, 1846, FFV. p. 184, pl. xi, figs. 9, 10.
,, ,, Brady, 1884, FC. p. 399, pl. l, figs. 7–10.

Station 6.

Two typical specimens.

219. *Bulimina ovata*, d'Orbigny.

Bulimina ovata, d'Orbigny, 1846, FFV. p. 185, pl. xi, figs. 13, 14.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 638.

Station 6, 7, 28.

One record only in the Antarctic. Very fine specimens at Stations 6 and 17. At Station 6 many have apical spines, a not uncommon variation in this species, as in *B. pyrula*.

220. *Bulimina affinis*, d'Orbigny.

Bulimina affinis, d'Orbigny, 1839, FC. p. 105, pl. ii, figs. 25, 26.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 638.

Stations 6, 7 (+ T. d. F.).

A fine typical example at Station 6, poor at Station 7.

221. *Bulimina marginata*, d'Orbigny.

Bulimina marginata, d'Orbigny, 1826, TMC. p. 269, no. 4, pl. xii, figs. 10–12.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 640.

Stations 2–4, 6, 8, 13, 14, 41, 49 (+ R. d. J.).

Never very abundant, excepting at Station 6, where a fine series, running into *B. aculeata*, was found.

222. *Bulimina aculeata*, d'Orbigny.

Bulimina aculeata, d'Orbigny, 1826, TMC. p. 269, no. 7.
" " Cushman, 1910, etc., FNP. 1911, p. 86, fig. 139.

Stations 3, 6–12, 14, 27, 29, 31, 32, 41 (+ R. d. J.).

Best in the N.Z. area, especially Stations 9, 10, and 11. At Station 10 a double specimen with two apertures. The spines are most pronounced in the deep-water Stations, reaching a maximum at Station 27 where, however, the species was uncommon.

223. *Bulimina echinata*, d'Orbigny.

Bulimina echinata, d'Orbigny, 1826, TMC. p. 269, no. 5.
" " Heron-Allen and Earland, 1914, etc., FKA. p. 640; 1916, FWS. p. 235, pl. xli, fig. 3.

Stations 10–12, 31.

This species differs from *B. aculeata* by being finely hispid all over the surface of the chambers instead of having the spines confined to their margins. It is very rare, but well marked specimens occur, the best at Station 11.

224. *Bulimina inflata*, Seguenza.

Bulimina inflata, Seguenza, 1862, RFC. p. 109 (p. 25 in the reprint), pl. i, fig. 10.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 641.

Stations 6, 7.

Extremely rare, but very typical.

225. *Bulimina buchiana*, d'Orbigny.

Bulimina buchiana, d'Orbigny, 1846, FFV. p. 186, pl. xi, figs. 15–18.
,, ,, Cushman, 1910, etc., FNP. 1911, p. 85, fig. 138.

Stations 6, 7, 9.

Very good and fairly numerous at Station 7. Typical at Station 6, typical but very small at Station 9.

226. *Bulimina rostrata*, Brady.

Bulimina rostrata, Brady, 1884, FC. p. 408, pl. li figs. 14, 15
,, ,, Cushman, 1910, etc., FNP. 1911, p. 87, fig. 140.

Station 7.

A good many typical specimens.

227. *Bulimina elegantissima*, d'Orbigny.

Bulimina elegantissima, d'Orbigny, 1839, FAM. p. 51, pl. vii, figs. 13, 14.
,, ,, Heron-Allen and Earland, 1911, etc., FKA. 1915, p. 639.

Stations 2, 3, 6, 8, 38.

Rare, the best at Station 6. One large specimen at Station 38.

228. *Bulimina elegantissima*, var. *seminuda*, Terquem.

Bulimina seminuda, Terquem, 1882, FEP. p. 117, pl. xii (xx), fig. 21.
,, *elegantissima*, var. *seminuda*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 639.

Stations 1, 2, 5, 6, 27.

Abundant and very variable. A single specimen only, in the Antarctic. Two distinct types, megalospheric and microspheric, occur together at all the N.Z. Stations, and the shape of the shell is mainly influenced by this character of the primordial chamber, the microspheric specimens being acutely pointed and increasing in width gradually to the oral extremity, whereas the megalospheric are bluntly rounded at the apex and show very little increase in width with the growth of the shell. At Station 6, where a very fine series of all sizes and types occurred, a pair was found in association (not budding, as described by us elsewhere (H.-A. 1915, RPF. p. 248, pl. xv, figs. 28 *a–f*)), but specimens were found here and at other Stations with absorbed terminal walls, suggesting this condition. Many of the microspheric specimens approach Sidebottom's var. *fusiformis* (S. 1918, FECA. p. 123, pl. iii, figs. 8–10), but rarely show the exaggerated tapering towards the oral extremity from the mid-growth of the shell, which characterizes his variety. In the same way, many of these specimens are furnished with a blunt spine at the apex, but only one example bearing a terminal spine and referable to Chapman's var. *apiculata* was found, at Station 6 (C. 1907, TFV. p. 31, pl. iv, fig. 77; and S. 1918, FECA. p. 123, pl. iii, fig. 11).

229. *Bulimina subteres*, Brady.

Bulimina subteres, Brady, 1879, etc., RRC., 1881, p. 55; 1884, FC. p. 403, pl. L, figs. 17, 18.
,, ,, Heron-Allen and Earland, 1913, CI. p. 62, pl. iv, figs. 13, 14.

Stations 3, 6, 27, 31, 55.

Rare but very typical, and all equally good.

230. *Bulimina declivis*, Reuss.

Bulimina declivis, Reuss, 1863-4, KTF. p. 55, pl. vi, figs. 70 *a*, *b*; pl. vii, fig. 71.
,, ,, Brady, 1884, FC. p. 404, pl. L, 19 *a*, *b*.

Station 6.

An excellent and typical series of this rare form at this single Station.

231. *Bulimina williamsoniana*, Brady.

Bulimina williamsoniana, Brady, 1879, etc., RRC. 1881, p. 56; 1884, FC. p. 408, pl. li, figs. 16, 17.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 641.

Stations 5, 6.

A good many typical specimens. Some show an absorbed final chamber which may indicate viviparity, not hitherto recorded in this species.

232. *Bulimina convoluta*, Williamson.

Bulimina pupoides, var. *convoluta*, Williamson, 1858, RFGB. p. 63, pl. v, figs. 132, 133.
,, *convoluta*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 641.

Station 6.

A single specimen, of Williamson's original type, not Millett's Malay type.

233. *Bulimina chapmani*, sp. nov. Pl. IV, figs. 18–20.

Bulimina seminuda, Chapman, 1914, FORS. p. 29, pl. ii, fig. 9 *a*, *b*.

Stations 26, 27, 31, 38, 45 47, 48, 53, 55.

Test free, perforate, helicoid. Consisting of a double series of chambers, arranged in a rapidly increasing spiral, the outer series being largely predominant and increasing in size much more rapidly than the inner series. Sutural lines flush, but often thick, and showing as bands of clear shell-substance. The oral face of the final chamber flat, containing the aperture, which is a well-marked cleft running half-way across the septal face.

Size (across oral face): Length up to ·80 mm.; breadth up to ·60 mm.; thickness up to ·50 mm.

The specimen figured by Chapman as *B. seminuda* (*ut supra*) bears practically no resemblance to Terquem's species, but is identical with our form. The nearest relation of the species appears to be the *Ataxophragmium humile* of Karrer (K., 1878, FTTL. p. 85, pl. v., fig. 3), but Karrer's figure gives us no

suggestion of the double series of chambers, and the test is arenaceous in texture. *B. contraria* (Reuss) (R., 1851, FSUB. p. 76, pl. v, fig. 37) is closely related, but in this species also, none of the published figures or descriptions give any clue to the biserial arrangement, and in addition, *B. contraria* has a turgid and rounded final chamber instead of the abruptly truncate face of *B. chapmani*. The species is typical of the Antarctic area, occurring at many stations from Nos. 26 to 55, but appears to be confined to the shallower waters, no specimens being observed in the deep-water Stations, the deepest specimen being recorded from 300 fms. (Station 55).

The shell is apparently built in layers, as dead specimens give indications of exfoliation.

234. *Bulimina squammigera*, d'Orbigny.

Bulimina squammigera, d'Orbigny, 1839, FIC. p. 137, pl. i, figs. 22–24.
„ „ Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 642, pl. xlvii, figs. 31–35.

Stations 4, 7.

The specimens are poor.

VIRGULINA, d'Orbigny.

235. *Virgulina schreibersiana*, Czjzek.

Virgulina schreibersiana, Czjzek, 1848, FWB. p. 147, pl. xiii, figs. 18–21.
„ „ Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 642, pl. xlix, figs. 1–12.
„ *sub-depressa*, Fauré-Fremiet, 1914, FMAF. p. 6, pl. 0, fig. 8.

Stations 6–11, 16, 18–20, 22, 23, 27, 29, 31, 36 (+ T. d. F., R. d. J., D.).

Occurs at most Stations frequent and typical, but disappearing at Station 36. The best at Stations 10, 16, 18, 27. At Stations 7 and 36, specimens with apical spines.

236. *Virgulina subsquamosa*, Egger.

Virgulina subsquamosa, Egger, 1857, MSO. p. 295, pl. viii, figs. 19–21.
„ „ Cushman, 1910, etc., FNP. 1911, p. 92, fig. 145.

Stations 6, 10, 16, 26, 27, 30, 31 (+ R. d. J.).

The best series at Station 6. Good and typical specimens at most of the other Stations where it is recorded.

237. *Virgulina sub-depressa*, Brady.

Virgulina sub-depressa, Brady, 1881, FC. p. 416, pl. lii, figs. 14–17.
„ „ Cushman, 1910, etc., FNP. 1911, p. 93, fig. 147.

Stations 7, 22.

Very rare at the two Stations.

238. *Virgulina pauciloculata*, Brady.

Virgulina pauciloculata, Brady, 1884, FC. p. 414, pl. lii, figs. 4, 5.
" " Liebus, 1902, EOM. p. 81, pl. v, figs. 4 *a*, *b*.

Station 6.

A single typical specimen.

BIFARINA, Parker and Jones.

239. *Bifarina porrecta* (Brady). Pl. IV, figs. 23-26.

Bolivina porrecta, Brady, 1879, etc., RRC. 1881, p. 57; 1884, FC. p. 418, pl. lii, fig. 22.
Bifarina " Heron-Allen and Earland, 1915, FKA. p. 643.

Station 48.

One very large individual characterized by a great number of chambers, sixteen pairs, and the fact that, in growing, the long axis of the shell traverses almost an entire revolution is noteworthy.

240. *Bifarina porrecta*, var. *arenacea*, nov. Pl. IV, figs. 23–26.

Station 6.

At Station 6 some half dozen examples were obtained of an extremely interesting variety referable to this species, which has hitherto only been known in the hyaline condition. The test is regularly bolivine up to half its length, the chambers then become gradually elongate, the last pair of chambers being produced and terminating in a final oral extremity characteristic of *Bifarina* as opposed to its relative *Bolivina*. The test is composed of fine sand-grains agglutinated with ferruginous cement to form a neat matt surface.

The only form with which these N.Z. specimens could be confused is *Textularia fusiformis*, Chaster (C. 1892, FS. p. 58, pl. i, fig. 3), from which they differ in their rounded edge and oval section. The aperture at the end of a produced extension of the chamber resembles Chaster's form, which occupies a somewhat anomalous position in the genus *Textularia*, and might, perhaps with advantage, be transferred to *Bifarina*. The structure of the test is different, Chaster's species invariably using flakes of mica and other minerals.

Size: Length ·40–·45 mm.; maximum breadth ·10–·14 mm.; thickness ·08 mm.

BOLIVINA, d'Orbigny.

241. *Bolivina punctata*, d'Orbigny.

Bolivina punctata, d'Orbigny, 1839, FAM. p. 63, pl. viii, figs. 10–12.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 644.

Stations 2, 11, 14, 16, 19, 27, 31, 55 (+ R. d. J.).

At most Stations between 2 and 19 fairly common. At most Stations a long, narrow microspheric form was the only representative. At Stations 16 and

19 a shorter, stouter, megalospheric type only occurs. At Stations 6, 8 and 9 both forms are represented, the megalospheric being as a rule very scarce. The best specimens at Stations 4 and 6. At Stations 27 and 31 a very slender hyaline form only occurs.

242. *Bolivina punctata*, var. *arenacea* nov. Pl. IV, figs. 21, 22.

Stations 27, 29, 41, 44, 45, 50, 52, 53, 55 (+ D.).

Between Stations 19 and 27 there are no records of *B. punctata*. At Station 27 the form recurs both in the type and with an arenaceous isomorph which is found at intervals as far south as Station 55. All the specimens are practically identical, constructed somewhat coarsely of fine sand-grains without much cement, so that the surface is rough. They are rather broad at their maximum width, as if it were a passage-form between *B. punctata* and *B. dilatata*, the aperture is very obscure, but in the best specimens is a short compressed tube (bifarine) at the extremity of the final chamber. All the specimens appear to be microspheric.

Size :—Length, ·35 mm. ; maximum breadth, ·13 mm. ; thickness, ·08 mm.

243. *Bolivina textilarioides*, Reuss.

Bolivina textilarioides, Reuss, 1862, NHG. p. 81, pl. x, fig. 1.
,, ,, Brady, 1884, FC. p. 419, pl. lii, fig. 23 (only).

Stations 9, 27 (+ R. d. J.).

A few specimens at Station 9, and one at Station 27, of the smooth type originally figured by Reuss.

244. *Bolivina textilarioides*, var. *spinescens*, Cushman.

Bolivina textilarioides, Brady, 1884, FC. p. 419, pl. lii, figs. 24, 25.
,, ,, Brady, Parker and Jones, 1888, AB. p. 221, pl. xliii, fig. 1.
,, ,, Millett, 1898, etc., FM. 1900, p. 542, pl. iv, fig. 5.
,, ,, Heron-Allen and Earland, 1908, etc., SB. 1911, p. 316, pl. x, figs. 10–12.
,, ,, Heron-Allen and Earland, 1916, FWS. p. 238, pl. xli, figs. 10–11.
,, *spinescens*, Cushman, 1910, etc., FNP. 1911, p. 46, fig. 76.

Stations 2, 5, 6, 8–11, 55 (+ D.).

Cushman founds his variety upon two of Brady's figures of *B. textilarioides*, Rss. The figures differ from the true Reuss type in the roughness of the sutural depressions. There is no doubt that this rough type is much more widely distributed and abundant than the true *B. textilarioides*, and there would be great difficulty in identifying past records of Reuss's species. But it seems desirable that two forms should be distinguished in future, although we consider them to be very closely allied and not exhibiting greater variation than is recognised in many other species. The N.Z. area furnishes an excellent series of var. *spinescens*, especially at Stations 9, 10, and 11, where the sutural

depressions on the first half of the shell are distinctly granular and the apex and margin often spinous.

245. *Bolivina lobata*, Brady.

Bolivina lobata, Brady, 1879, etc., RRC. 1881, p. 58; 1884, FC. p. 425, pl. liii, figs. 22, 23.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 647.

Stations 4, 6, 7, 8.

Very well developed at Station 6.

246. *Bolivina dilatata*, Reuss.

Bolivina dilatata, Reuss, 1849–50, FOT. p. 381, pl. iii (xlviii), fig. 15.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 645.

Stations 2, 6, 8, 11, 31 (+ R. d. J.).

Curiously rare. The best specimen a solitary Antarctic individual from Station 31; the others far from typical.

[Arenaceous isomorph, *Bolivina arenosa*, Chap. 1895, FAS. p. 24, pl. i, fig. 3.]

247. *Bolivina beyrichi*, Reuss.

Bolivina beyrichi, Reuss, 1851, FSUB. p. 83, pl. vi, fig. 51.
" " Heron-Allen and Earland, 1916, FWS. p. 239, pl. xli, fig. 15.
" " Cushman, 1910, etc., FNP. 1911, p. 34, fig. 56.

Stations 8, 9.

Extremely rare, but typical.

248. *Bolivina beyrichi*, var. *alata* (Seguenza).

Valvulina alata, Seguenza, 1862, RFC. p. 115, pl. ii, figs. 5, 5*a*.
Bolivina beyrichi, var. *alata*, Brady, 1884, FC. p. 422, pl. liii, figs. 2–4.
" " " Bagg, 1912, PFC. p. 40, pl. x, figs. 7–9.

Stations 3, 8.

One large specimen at Station 3, and several very fine examples at Station 8.

249. *Bolivina aenariensis* (Costa).

Brizalina aenariensis, Costa, 1853, etc., PRN. 1856, p. 297, pl. xv, figs. 1, 2.
Bolivina aenariensis, Cushman, 1910, etc., FNP. 1911, p. 44, fig. 71.

Station 6.

The specimens are all very weak.

250. *Bolivina decussata*, Brady.

Bolivina decussata, Brady, 1879, etc., RRC. 1881, p. 58; 1884, FC. p. 423 pl. liii, figs. 12, 13.
" " Cushman, 1910, etc., FNP. 1911, p. 47, fig. 77.

Stations 22.

An unquestionable example.

251. *Bolivina difformis* (Williamson).

Textularia variabilis, var. *difformis*, Williamson, 1858, RFGB. p. 77, pl. vi, figs. 166, 167.
Bolivina pygmaea, Brady, 1884, FC. p. 421, pl. liii. figs. 5, 6.
,, *difformis*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 645.

Stations 8, 9.

A few very good specimens.

252. *Bolivina variabilis* (Williamson).

Textularia variabilis (*typica*), Williamson, 1858, RFGB. p. 76, pl. vi, figs. 162, 163 (incorrectly numbered 161, 162 on the plate).
Bolivina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 647.

Stations 2, 5, 7, 8.

Rare. The best at Stations 2 and 8, quite typical.

253. *Bolivina inflata*, Heron-Allen and Earland.

Bolivina inflata, Heron-Allen and Earland, 1913, CI. p. 68, pl. iv, figs. 16–19; 1915, FKA. p. 648; 1916, FSC. p. 43; 1916, FWS. p. 240.

Stations 4, 5, 6, 9.

Very rare, a few small but typical specimens in the N.Z. area only.

254. *Bolivina inflata*, var. *arenacea*, nov. Pl. IV, figs. 31–33.

At Stations 2 and 6 (N.Z.) and at Station 55 (Ant.) a few minute arenaceous isormorphs were found. They are slightly larger than the hyaline form, but otherwise correspond, except in the constitution of the test, which is built up almost entirely of ferruginous cement in which hardly any trace of mineral grains can be seen under a fairly high power. The shell-wall is extremely thin and delicate.

Size :—Length, ·15 mm.; breadth, ·12 mm.; thickness, ·08 mm.

255. *Bolivina plicata*, d'Orbigny.

Bolivina plicata, d'Orbigny, 1839, FAM. p. 62, pl. viii, figs. 4–7.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 648.

Stations 2, 3, 5, 6, 8–10.

Fairly plentiful, very good and typical specimens at Stations 5 and 6.

256. *Bolivina reticulata*, Hantken.

Bolivina reticulata, Hantken, 1875, CSS. p. 65, pl. xv, fig. 6.
,, ,, Millett, 1898, etc., FM. 1900, p. 547.

Stations 6, 7, 9–11.

The records are few and the specimens are nearer Hantken's original figure than Brady's. With a few exceptions they all represent a variety with a sharply truncate marginal edge, and practically parallel faces. This gives the test a very compressed appearance.

257. *Bolivina karreriana*. Brady.

Bolivina karreriana, Brady, 1879, etc., RRC. 1881, p. 58; 1884, FC. p. 424, pl. liii, figs. 19–21.
" " Cushman, 1910, etc., FNP. 1911, p. 40, fig. 65.

Stations 4, 6, 8.

Very rare, except at Station 6, where it is abundant and beautifully developed, the apical spine often attaining great length.

258. *Bolivina obsoleta* (Eley).

Textularia obsoleta, Eley, 1859, Geology in the Garden, p. 202, pl. viii, fig. 11c.
" *quadrilatera*, Schwager, 1886, FKN. p. 253, pl. vii, fig. 103.
" " Millett, 1898, etc., FM. 1899, p. 559, pl. vii, fig. 3.
Bolivina obsoleta, Heron-Allen and Earland, 1908, etc., SB. 1910, p. 409.

Station 6.

A very fine series of specimens, all megalospheric. Some of them show a strong tendency to a spiral twist. We see no reason to depart from the opinion we expressed in 1910. Reuss used the name *Textularia obsoleta* (R. 1845–46, FBK. pt. 1, p. 39, pl. xiii, fig. 79) for a species which he admits is probably the same as *T. laevis*, Roemer (R. 1841, VNK. p. 97, pl. xv, fig. 17). They appear to us to be identical, and Reuss's name must therefore lapse.

259. *Bolivina tortuosa*, var. *arenacea*, nov. Pl. IV, figs 34, 35.

Station 2 (+ D.).

A single specimen exhibiting the characteristic flexure of this form, but with a test constructed of very fine sand-grains and ferruginous cement. But for the curve in the axis of growth this form would be inseparable from our *B. inflata*, var. *arenacea*, and raises once more the question of the specific value of *B. tortuosa*, to which we referred under that species in 1916 (H.-A. & E. 1916, FWS. p. 240). The aperture is a small compressed tube (bifarine) at the extremity of the final chamber.

Size:—Length, ·25 mm.; breadth, ·13 mm.

260. *Bolivina robusta*. Brady.

Bolivina robusta, Brady, 1879, etc., RRC. 1881, p. 57; 1884, FC. p. 421, vol. liii, figs. 7, 9.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 646.

Stations 1–3, 6–8, 10, 11, 32 (+ R. d. J.).

Abundant in the N.Z. area, but represented by a single typical specimen only in the Antarctic. At most of the Stations the prevalent type is a very decorative variety with strongly limbate sutural lines which are coarsely perforate, the walls of the chambers themselves being clear and free from perforation. Brady's type without limbation occurs at Stations 6, 10, and 11, with the limbate variety. A very fine series of specimens were obtained at Station 6, 10 and 11, representing both megalospheric and microspheric specimens. At Stations

10 and 11 all the typical non-limbate specimens bear a spine at the initial extremity. At Station 10 the species appears to be subject to great abnormalities. Among the "freaks" observed were many instances of marked depauperation at half growth, succeeded by recovery, giving a lyriform outline to the test. Other instances of spiral twists in the axis, reversed axes, and fracture and repair of the shell, the best instance of which was found at Station 6.

261. *Bolivina limbata*, Brady.

Bolivina limbata, Brady, 1879, etc., RRC. 1881, p. 57; 1884, FC. p. 419, pl. liii, figs. 26–28.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 646, pl. L, figs. 1–4.

Station 2.

A good specimen.

SUB-FAMILY CASSIDULININAE.

CASSIDULINA, d'Orbigny.

262. *Cassidulina laevigata*, d'Orbigny.

Cassidulina laevigata, d'Orbigny, 1826, TMC. p. 282, No. 1, pl. xv, figs. 4, 5.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 652.

Stations 1–9, 11, 27, 31, 48, 55 (+ K. I., R. d. J., D.).

Generally distributed, but never very abundant. The best Stations were No. 6 in the N.Z. area, and Nos. 27, 31 in the Antarctic. The predominant type at all Stations, except Stations 2 and 3, is a sharply-keeled form, Brady's fig. 3 (FC. pl. liv). At Stations 2 and 3 the original form figured in the "Tableau Méthodique" appears in company with the carinate form. At Station 6 a double specimen, due to what, at present, we regard as fusion of primordial chambers.

263. *Cassidulina laevigata*, var. *tumida*, nov. Pl. V, figs 8–10.

Stations 1, 2, 3.

Chambers arranged as in the type, but differing in the structure of the shell, which is strongly biconvex and very thick walled. Sutures obscure but, when visible, strongly limbate. Surface of the shell often slightly rough. Peripheral edge rounded; never keeled.

This variety, which is very distinctive, can hardly be mistaken for the type or any of the many figured forms attributed to *C. laevigata*. The outstanding feature is the extraordinary thickness of the shell-wall, which has the appearance of being deposited in layers, as the latest formed chambers are usually thinner walled and clearly distinguishable in outline, whilst all the earlier ones in the same individual have become almost indistinguishable from one another. It is very local, occurring only at Stations 1, 2 and 3, where, however, it is perhaps more abundant than the typical *C. laevigata*, which also occurs at these Stations.

Size:—Breadth, ·30–·40 mm.; thickness, ·20–·25 mm.

264. *Cassidulina crassa*, d'Orbigny.

Cassidulina crassa, d'Orbigny, 1839, FAM. p. 56, pl. vii, figs. 18–20.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 652.

Stations 1–3, 5–11, 19, 20, 26, 27, 31, 35, 38, 45–50, 53–55 (+ K. I., R. d. J., D.).

Almost universally distributed, and increasing in size and abundance to the South. At the most southerly Stations it reaches an almost unprecedented development in size and thickness of shell, the substance being evidently deposited in layers, as dead specimens show exfoliation of the surface. At Station 3 a double specimen.

265. *Cassidulina oblonga*, Reuss.

Cassidulina oblonga, Reuss (*non* d'Orbigny), 1849–50, FOT. p. 376, pl. iii (xlviii), figs. 5, 6.
" *crassa* (*pars*), Brady, 1884, FC. p. 429, pl. liv, fig. 4 (only).

Stations 3, 6, 26, 27, 38, 45, 46, 47, 48, 50, 53, 54 (+ D).

This can only be regarded as a modification of the *C. crassa* type, but it possesses an individuality of its own in the tendency to inflation of chambers and the oblong outline of the whole test. It occurs in company with *C. crassa* at many Stations and passage-forms are common. As with *C. crassa* it reaches a maximum development in size at the southerly Stations, the best being at Stations 38, 45 and 54.

266. *Cassidulina subglobosa*, Brady.

Cassidulina subglobosa, Brady, 1879, etc., RRC. 1881, p. 60; 1884, FC. p. 430, pl. liv, fig. 17.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 652.

Stations 1–8, 10, 11, 16, 18–20, 22, 26, 27, 29–31, 36, 38, 45–50, 52–55 (+ T. d. F., K. I., R. d. J., D.).

Almost universally distributed, but, unlike *C. crassa* and *oblonga*, the form does not show that marked tendency to increase in development to the South. There are a few exceptions at Stations 38, 48 and 54, where individuals of very large size occur, but otherwise the Antarctic *C. subglobosa* is in no way different from the N.Z., and as a general rule the specimens are not so well developed as at the best N.Z. Station 6. Passage-forms into *C. crassa* and *oblonga* are frequent. [Arenaceous isomorph. *Cassidulina devonica*, Chap., J.R.M.S. 1922, p. 334, pl. viii, fig. 8.]

267. *Cassidulina subglobosa*, var. *tuberculata*, nov. Pl. IV, figs. 36-38.

Stations 30, 31 (+ D.).

At these Stations a variety of *C. subglobosa*, characterized by the ornamentation of all but the last formed chambers, with minute tubercles of shell-matter, occurred. Decoration of any kind is so rare among the Cassidulinae that this variation, which would pass unnoticed in many other genera, seems worthy of a varietal name in this place. It may be compared with Sidebottom's *C. decorata* (JQMC, Ser. 2, vol. xi,

p. 107, pl. iv, fig. 2), which is merely *C. subglobosa* covered with a reticulate ornament of shell-substance, but much more pronounced than in this tuberculate variety.

Size :—Length, ·40–·50 mm. ; breadth, ·35–·40 mm.

268. *Cassidulina calabra* (Seguenza).

Bursculina calabra, Seguenza, 1879–80, FTR. p. 138, pl. xiii, figs. 7 *a*, *b*.
Cassidulina ,, Brady, 1884, FC. p. 431, pl. cxiii, figs. 8, *a c*.
,, ,, Bagg, 1912, PFC. p. 42, pl. xii, figs. 1, *a c*.

Stations, 2, 3, 6, 18, 22.

The records are few, and the Antarctic ones depend on single specimens at Stations 18 and 22, both deep water. The N.Z. examples are all from the sub-fossilized foraminiferal rock (see Description of Material), from Stations 2, 3 and 6. This seems to be conclusive that these sub-fossilized deposits were not laid down under the same conditions as the recent material from the same Stations.

269. *Cassidulina bradyi*, Norman.

Cassidulina bradyi (Norman MS.), Wright, 1880, NEL. p. 152.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 653.

Stations 1–8 (+ R. d. J.).

Confined to the N.Z. area and fairly plentiful at the Stations where it is found. All the examples belong to the sharp edged, broad type figured by Brady (fig. 10), and, except at Station 6, nearly all the specimens observed show but the feeblest signs of the rectilinear series of chambers; in fact but for the very characteristic appearance of the wall of the test, as compared with *C. laevigata*, the specimens might have been regarded as a mere variation of that type. At Station 6 the rectilinear series was frequently developed to a much greater length than Brady's figures would indicate, and there is an increasing tendency in the latest formed chambers to lose the sharp marginal edge and to approach the rounded cross-section of Brady's fig. 7. (FC. pl. liv.)

270. *Cassidulina bradyi*, Norman, var. *elongata*, Sidebottom.

Cassidulina bradyi, var. *elongata*, Sidebottom, 1904, etc., RFD. 1905, p. 17, pl. iii, fig. 11.
,, ,, ,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 653, pl. l, fig. 20.

Station 55.

A single small but typical specimen from this most southerly point. It is a most interesting "find," in view of the fact that the very few recorded observations now cover the North Sea, the Mediterranean, tropical East Africa and "Farthest South," the only four records in existence.

271. *Cassidulina parkeriana*, Brady.

Cassidulina parkeriana, Brady, 1879, etc., RRC. 1881, p. 59; 1884, FC. p. 432, pl. liv, figs. 11–16.

Stations 5, 6, 27, 31, 38, 45–48, 50, 54 (+ D.).

Very rare in the N.Z. area (only Stations 5 and 6), where the specimens were few and small. At Station 6 the single specimen, though small, had a greater development of the rectilinear series of chambers than was observed anywhere else. In the Antarctic the species is much more abundant, attaining a large size and considerable thickness of shell-wall, but the rectilinear chambers are, as a rule, but short, the specimens being of a stout inflated type similar to Brady's fig. 14. The best individuals at Stations 38, 45, 48 and 50.

272. *Cassidulina nitidula* (Chaster).

Pulvinulina nitidula, Chaster, 1892, FS. p. 66, pl. i, fig. 17.
Cassidulina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 653.

Station 27.

A single typical specimen.

EHRENBERGINA. Reuss.

273. *Ehrenbergina serrata*, Reuss.

Ehrenbergina serrata, Reuss, 1849–50, FOT. p. 377, pl. iii (xlviii), figs. 7, *a–c*.
,, ,, Cushman, 1910, etc., FNP. 1911, p. 101, fig. 155.

Stations 1–3, 6, 8, 17, 18.

This is one of the most typical Foraminifera in the N.Z. area, and at those Stations where it occurs is both abundant and varied, the variation being principally in the development of the spinous margin. The single specimen from the Antarctic is differentiated by the marked development of the spines on the central line, which are generally entirely suppressed in the N.Z. area. Excellent glauconitic casts from Station 6.

274. *Ehrenbergina hystrix*, Brady.

Ehrenbergina hystrix, Brady, 1879, etc., RRC. 1881, p. 60; 1884, FG. p. 434, pl. lv, figs. 8–11.
,, ,, Cushman, 1910, etc., FNP. 1911, p. 102, fig. 156.

Station 18.

The only individuals which agree entirely with Brady's description and figure were found at Station 18; they present the characteristic thickening of the shell with spinulation over the whole of the early chambers.

275. *Ehrenbergina hystrix*, var. *glabra*, nov. Pl. V, figs. 1–6, 11.

Stations 2, 6, 11, 26, 27, 31, 38, 45–48, 50, 53–55 (+ D.).

One of the most typical and abundant forms in the Antarctic is the variety for which we propose this name, on account of its smooth and highly polished surface-texture, and the entire absence of the superficial spines which characterize the early chambers of Brady's type. The variety otherwise bears a strong resemblance

to Brady's figures of *E. hystrix*, notably in the convexity of the dorsal side and the involution of the earlier chambers. The oral face, however, is more flattened than in the type, the aperture is situated nearer to the marginal edge, and the striations round the aperture are often entirely absent and never very marked. The marginal spines vary enormously in development, but, as a rule, are relatively most prominent in small individuals, whereas in the comparatively large specimens which occur at the most southerly Stations they are inconspicuous and in some cases almost or entirely lacking.

Double individuals occur at Station 48. Practically, if not absolutely, all the specimens are very distinctly megalospheric. This brings the form directly into contrast with *E. serrata*. Out of an enormous number of specimens of that species which we have examined, practically all were microspheric; the possibility that our var. may be the megalospheric type of *E. serrata* must not be lost sight of, but against this suggestion may be set the fact that its distribution is markedly Antarctic, the variety being represented by single specimens only at Stations 2, 6 and 11, whereas *E. serrata*, so abundant in the N.Z. area, does not occur in company with var. *glabra*, except at Stations 2, 6, 11 and 18, which latter alone is outside the N.Z. area, and is our most southerly record.

Size:—Length, ·35–·60 mm.; breadth, with spines, up to ·60 mm.; thickness up to ·30 mm.

Family CHILOSTOMELLIDAE.

SEABROOKIA, Brady.

276. *Seabrookia earlandi*, Wright.

Seabrookia earlandi, Wright, 1891, SWI. p. 477, pl. xx, figs. 6, 7.
" " Heron-Allen and Earland, 1913, CI. p. 72, pl. v, figs. 10–12.

Stations 6, 8–11, 16, 17, 27, 31, 55 (+ D.).

Occurs in both areas down to the southernmost limit. A good many specimens, the best at Station 10. In the Antarctic, especially at Stations 16 and 27, the type is longer and more milioline than usual, the final chamber in some cases only partially covering its predecessor. In a few instances, in fact, the specimens were practically isomorphs of *Miliolina cultrata*.

277. *Seabrookia pellucida*, Brady.

Seabrookia pellucida, Brady, 1890, JRMS. p. 570, text-figs. 60, 1*a–c*, 2.
" " Millett, 1898, etc., FM. 1901, p. 3 pl. i, fig. 4.

Stations 2, 6.

A few specimens of the type figured by Millett without the serrated aboral end. Their occurrence outside the Malay area, to which all previous records refer, is remarkable, if, as seems probable, Brady's reference to its discovery at "Challenger" Station 33 (Bermuda, 435 fms.), is a mistake for the commoner type *S. earlandi*, which he failed to differentiate from his own species.

CHILOSTOMELLA, Reuss.

278. *Chilostomella ovoidea*, Reuss.

Chilostomella ovoidea, Reuss, 1849-50, FOT. p. 380, pl. iii (xlviii), fig. 12.
" " Brady, 1879, etc., RRC. 1879, p. 66, pl. viii, figs. 11, 12; 1884, FC. p. 436, pl. lv, figs. 12-23.
" " Millett, 1898, etc., FM. 1901, p. 2, pl. i, figs. 2, 3.

Stations 6, 7.

A good many specimens at each Station, attaining a large size. Two forms occur at both Stations, representing the two distinct types figured and recorded by Millett, *ut supra*.

FAMILY LAGENIDAE.

SUB-FAMILY LAGENINAE.

LAGENA, Walker and Boys.

279. *Lagena globosa* (Montagu).

Serpula (*Lagena*) *laevis globosa*, Walker and Boys, 1784, TMR. p. 3, pl. i, fig. 8.
Lagena globosa, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 654.

Stations 2, 3, 6-10, 11, 14, 16-18, 20, 22, 23, 26, 27, 31, 36, 38, 45, 46, 48, 50, 53-55 (+ T. d. F., R. d. J., D.).

Almost universally distributed, as usual, very variable both in size and, within limits, in shape. The finest specimens at Stations 18, 38, 50, 53 and 54. Specimens having an entosolenian tube occur at many Stations, especially Stations 6, 18, 38, 45 and 48, the best at Station 45, where an exceptionally large individual, furnished with a short produced neck at each pole and a straight internal tube running almost across the shell, was found. A gigantic specimen at Station 54. At Station 50 a very large abnormal specimen with a produced neck, similar to fig. 11*k*, in Brady, FC, p. 441. Compressed individuals at many Stations. Double specimens at Stations 7, 9, 10. At Station 7 a pair joined by the apex, at Station 9 a pair joined by the base, and at Station 10 a pair joined base to side. The Antarctic specimens are, as usual, larger than normal, and the surface is marked with excessively fine striae.

280. *Lagena globosa*, var. *lineato-punctata*, nov. Pl. V, figs. 12-14.

Stations 6, 11.

Test globose to pyriform, with slightly protruding neck, and a clear spot of shell-substance in the middle of the base. Surface glassy, but "frosted" in appearance. Under a high magnification this is seen to be due to fine depressions set in close regular lines extending from base to neck. There is no indication that these depressions are perforate.

Several specimens at Station 6. Very rare at Station 11.

Dimensions:—Length, ·20-·27 mm.; breadth, ·17-·20 mm.

281. *Lagena apiculata* (Reuss).

Oolina apiculata, Reuss, 1851, FKL. p. 22, pl. i, fig. 1.
Lagena ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 651.

Stations 1, 2, 6, 17, 23, 27, 31, 38 (+ T. d. F., D.).

This pointed variety of *L. globosa* is much rarer than the type. Very fine specimens at Stations 23, 27 and 31.

[Arenaceous isomorph, *Reophax difflugiformis*, Brady (*pars*), = *R. ovulum*, Grzbw., 1895, OWI., and *Haplophragmium lagenarium*, Berthelin (B., 1880, EAM. p. 21, pl. i., fig. 2).]

282. *Lagena longispina*, Brady.

Lagena longispina, Brady, 1879, etc., RRC, 1881, p. 61; 1884, FC. p. 454, pl. lvi, figs. 33, 36, pl. lix. figs. 13, 14.
,, ,, Sidebottom, 1912, etc., LSP. 1913, p. 165, pl. xv, figs. 5, 6.

Stations 17, 20, 36.

Very rare, and, excepting at Station 20, small. The spines range between two and three in number and are very long.

283. *Lagena ovum* (Ehrenberg).

Miliola ovum, Ehrenberg, 1843, MMO. p. 166; 1854, M. pl. xxiii, fig. 2, pl. xxix, fig. 45, pl. xxxi, fig. 4.
Lagena ,, Heron-Allen and Earland, 1913, CI. p. 73, pl. vi, fig. 1.

Station 36.

Several typical individuals.

284. *Lagena botelliformis*, Brady.

Lagena botelliformis, Brady, 1879, etc., RRC. 1881, p. 60; 1884, FC. p. 454, pl. lvi, fig. 6.
,, ,, Millett, 1898, etc., FM. 1901, p. 492, pl. viii, fig. 15.

Stations 6, 9–11, 16–18, 20, 22, 27, 31, 36 (+ T. d. F., D.).

Widely distributed, especially in the deep-water Stations, the best at Stations 16, 17 and 36. Those from the N.Z. area are less distinctive, but good at Station 11. An apiculate form occurs at Station 9.

285. *Lagena laevis* (Montagu).

Vermiculum laeve, Montagu, 1803, TB. p. 524.
Lagena laevis, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 657.

Stations 2, 6–8, 10, 11, 16 18, 22, 26, 36 (+ K. I., D.).

Generally distributed as far south as Station 36, often frequent. There is an enormous range of variations, the usual tendency to the production of a very long neck in deep water being observable. The best of this latter type, in which the body ranges from nearly globular to oval or cylindrical, are at Stations 16, 17 and 22. At Stations 16 and 22 the specimens are very delicately spinous

round the neck, and show evidence of the same ornament sometimes on the body. These specimens might, perhaps, be equally well referred to *L. hispida*, representing a maximum stage of denudation, as referred to in our note on that species (see H.-A. & E., 1916, FWS. p. 243. pl. xli, fig. 16, *L. hispida*), but only these vestigial traces would suggest that they were anything but typical *L. laevis*.

[Arenaceous isomorph. *Reophax difflugiformis*, Brady.]

286. *Lagena sphaerula*, Silvestri.

Lagena sphaerula, Silvestri, 1902, LMT. p. 162, figs. 68–70.

Stations 2, 6.

Many excellent examples at Station 6, and one at Station 2. This form of Silvestri's with oral and basal produced apertures is isomorphous with Seguenza's *L. lyellii*, and occupies the same varietal position towards *L. laevis* that *L. lyellii* does to *L. sulcata*.

287. *Lagena gracillima* (Seguenza).

Amphorina gracilis, Costa, 1853, etc., PRN. 1856, p. 121, pl. xi, fig. 11.
Lagena gracillima, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 660.

Stations 2, 6, 9, 10, 16, 18, 20, 22, 29, 36 (+ K. I.).

Widely distributed but never abundant. The best specimens at Station 6, very large, and Station 36 medium in size, but with extraordinarily produced neck.

288. *Lagena elongata* (Ehrenberg).

Miliola elongata, Ehrenberg, 1841, Ber. k. preuss, Ak. Wiss. Berlin, p. 274; 1845, p. 371; 1851, M. pl. xxv, fig. 1, A. 1.
Lagena ,, Cushman, 1910, etc., FNP. 1913, p. 12, pl. 1, fig. 5.

Stations 6, 11, 17, 36.

Typical at Station 11, though small; less characteristic and nearer *L. gracillima* at the other Stations.

289. *Lagena aspera*, Reuss.

Lagena aspera, Reuss, 1861, FKM. p. 305, pl. i, fig. 5.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 655.

Stations 6, 10, 16–18, 22, 28.

Sparingly distributed, and only occasional specimens, but very representative. At Station 6 long-necked specimens of all degrees of coarseness of ornament. At Station 7 a globular specimen almost identical with Reuss's *L. rudis* (R. 1862, FFL. p. 336, pl. vi, fig. 82). At Stations 16, 17 and 22, the specimens are of the type usually associated with deep water, having a globular body and a short, thick neck ornamented with rings.

[Arenaceous isomorph, *Haplophragmium scruposum*, Berthelin (B. 1880, EAM. p. 21, pl. i, fig. 1).]

290. *Lagena ampulla-distoma*, Rymer Jones.

Lagena vulgaris, var. *ampulla-distoma*, Rymer Jones, 1872, LJS. p. 63, pl. xix, fig. 52.
,, *ampulla-distoma*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 655.

Station 6.

Typical, but very rare.

291. *Lagena hispida*, Reuss.

Lagena hispida, Reuss, 1858, FP. p. 434; 1862, FFL. p. 335, pl. vi, figs. 77–79.
,, ,, Heron-Allen and Earland, 1916, FWS. p. 243, pl. xli, fig. 16.

Stations 7, 8, 10, 11, 16, 18–20, 22, 23, 31, 36.

More widely distributed and abundant than *L. aspera*, and characterised by considerable variation, chiefly in the length of the neck which, in the deep-water Stations 16, 18, 19, 20, is very pronounced. Specimens with a complete armature of long fine spines, such as we find in the North Sea, do not occur. The spines as a rule are very short, sometimes amounting to nothing more than a matt surface to the test. At Station 16 some abnormal individuals isomorphous with *L. apiculata* and finely hispid were found.

292. *Lagena clavulus*, sp. nov. Pl. V, fig. 7.

Station 29.

Test elongate, pyriform, without a produced neck. The entire surface closely covered with bolt-like projections of uniform length, set in close parallel rows in the direction of the long axis of the test. Every protuberance has a slightly swollen extremity like the head of a nail, flat upon the outer surface.

Dimensions:—Length, ·25 mm.; breadth, ·12 mm.

The species is based on a single individual which is, however, so characteristic in appearance as to deserve special notice. It may be merely a highly distinctive variation of *L. hispida*, or it may represent a form in process of transition into the group of double-walled Lagenae of the *L. foveolata* group. There are faint indications of a delicate pellicle between some of the "studs" which give support to the latter theory.

293. *Lagena striata* (d'Orbigny).

Oolina striata, d'Orbigny, 1839, FAM. p. 21, pl. v, fig. 12.
Lagena ,, Brady, 1884, FC. p. 460, pl. lvii, figs. 22, 24, 28, 29, etc.
,, ,, Millett, 1898, etc., FM. 1901, p. 487.

Stations 2, 6–8, 11, 17, 22, 48, 55 (+ R. d. J.).

Ranges over the entire series of Stations. The best at Stations 6 and 7. Examples with a spinous base at Station 17. Very small at Station 55. At Station 48 a variety occurs in which certain of the costae are developed to a greater extent than the intervening ones, so as to separate the shell into a

septangular striate figure comparable with Sidebottom's figure (S. 1912, etc., LSP. 1912, p. 386, pl. xv, fig. 7), which has, however, only five prominent costae.

294. *Lagena lineata* (Williamson).

Entosolenia lineata, Williamson, 1848, BSGL. p. 18, pl. ii, fig. 18.
Lagena ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 656.

Stations 27, 38, 54.

Few records, best and most typical at Station 38. Coarsely striate at Station 27, and feebly so at Station 54.

295. *Lagena sulcata* (Walker and Jacob).

Serpula (*Lagena*) *striata sulcata rotundata*, Walker and Boys, 1784, TMR. p. 2, pl. i, fig. 6.
Lagena sulcata, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 659.

Stations 2–4, 6 11, 16–19, 22, 27, 28, 36, 45 (+ K. I., R. d. J., D.).

Widely distributed, the best at Stations 2, 6 and 45. At the deep-water Stations the form has a tendency to narrow, and to merge into *L. gracilis*. Spinous-based individuals occur at Stations 18, 19 and 36, at the last of which the spine is almost as long as the neck. At Station 16 the costae are developed very highly, standing out as wings. At Station 10 the examples have a very long neck, and at Station 45 this neck bears a spiral band of shell-substance. Williamson's variety *interrupta* occurs at Stations 7 and 22.

296. *Lagena lyellii* (Seguenza).

Amphorina lyellii, Seguenza, 1862, FMMM. p. 52, pl. i, fig. 40.
Lagena ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 659.

Stations 2, 5, 6, 20 (+ R. d. J.).

Frequent and typical but confined to few Stations, only one of which is Antarctic.

297. *Lagena acuticosta*, Reuss.

Lagena acuticosta, Reuss, 1862, FFL. p. 331, pl. v, fig. 63.
,, ,, Brady, 1884, FC. p. 464, pl. lvii, figs. 31, 32, pl. lviii, figs. 20, 21.
,, ,, Millett, 1898, etc., FM. 1901, p. 8.

Stations 6, 7, 10, 11, 16–19, 22, 23, 26, 31, 36, 38, 52, 55.

Widely distributed. Typical and fairly plentiful where it occurs, the best at Stations 10 and 11.

298. *Lagena williamsoni* (Alcock).

Entosolenia williamsoni, Alcock, 1865, NHC. p. 195.
Lagena ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 659.

Stations 2, 3, 8, 10 (+ K. I.).

Very rare, and except at Stations 8 and 10 the specimens are not very typical

299. *Lagena costata* (Williamson).

Entosolenia costata, Williamson, 1858, RFGB. p. 9, pl. i, fig. 18.
Lagena ,, Heron-Allen and Earland, 1914, FKA. 1915, p. 656.

Stations 2, 3, 5–7, 10, 11, 17, 18, 20, 22, 23, 26, 27, 31, 36, 38, 45, 53, 55 (+ T. d. F.).

Widely distributed and fairly common. The best N.Z. at Station 6. Weak and small at Stations 17, 26, and 36. Increasing in size at the southerly Stations. Very fine specimens at Stations 38, 45, 53 and 55.

300. *Lagena gracilis*, Williamson.

Lagena gracilis, Williamson, 1848, BSGL. p. 13, pl. i, fig. 5.
,, ,, Brady, 1884, FC. p. 464, pl. lviii, figs. 2, 3, 7–10, 19, 22–24.
,, ,, Millett, 1898, etc., FM. 1901, p. 492, pl. viii, figs. 12–14.

Stations 3, 9, 10, 11, 16–18, 20, 22, 23, 27, 31, 36, 55 (+ T. d. F., D.).

Generally distributed, but does not occur after Station 36 till we reach the extreme south at Station 55. Usually abundant and often very variable. The coarsely costate type, on the whole, predominates, but at the most representative Stations 16, 18 and 36, both coarsely and finely marked types occur in company. In the deep-water Stations the coarsely costate form often acquires extensive wing-like development of the costae.

301. *Lagena plumigera*, Brady.

Lagena plumigera, Brady, 1879, etc., RRC. 1881, p. 62; 1884, FC. p. 465, pl. lviii, figs. 25, 27.
,, ,, Millett, 1898, etc., FM. 1901, p. 490, pl. viii, fig. 8.

Stations 11, 14, 16.

Very rare except at Station 16, where a number of magnificent specimens were found rivalling even Haeckel's remarkable figure in beauty (Kunstformen der Natur, Leipzig, 1899. Pl. lxxxi, fig. 10). The spaces between the tubulated wings are sometimes smooth, but at others more or less strongly sulcate.

302. *Lagena semistriata*, Williamson.

Lagena striata, var. *semistriata*, Williamson, 1848, BSGL. p. 14, pl. i, figs. 9, 10.
,, *semistriata*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 658.

Stations 6, 7, 11, 31.

Few records and the specimens rare, but varying greatly in the development of the ornament. At Station 6 the individuals are large, but the ornament is confined to a small radiating star on the rounded base. At Station 7 the specimens have very long necks but weak costae, at Station 11 the costae are raised almost into wings and the neck, which is very long, is strengthened with a spiral band of shell-substance. At Station 31 a single neckless specimen, globular, and covered as to its lower half with innumerable fine costae.

303. *Lagena multicosta* (Karrer).

Fissurina multicosta, Karrer, 1877, HW. p. 379, pl. xvi, fig. 20.
" *bouei*, *Ibid.* p. 378, pl. xvi, fig. 19.
Lagena multicosta, Brady 1884, FC., p. 466, pl. lxi, fig. 4.
" " Millett, 1898, etc., FM. 1901, p. 495, pl. viii, fig. 17.

Station 36.

Some fine individuals of the "fissurine" form with abnormally developed costae on the basal half, the superior half of the shell being smooth.

304. *Lagena stelligera*, Brady.

Lagena stelligera, Brady, 1879, etc., RRC. 1881, p. 60; 1884, FC. p. 466, pl. lvii, figs. 35, 36
" " Sidebottom, 1912, etc., LSP. 1912, p. 391, pl. xv, figs. 28, 29; pl. xvi, figs. 1–4; 1913, p. 174.

Stations 10, 16–19, 23, 36 (+ T. d. F., K. I., D.).

Presenting great variation, both in length of neck, development of the basal cup, rotundity and compression, smoothness and striation, and coarseness of sulcae. The best at Station 36, where practically every development occurs.

305. *Lagena stelligera*, var. *excentrica*, Sidebottom.

Lagena stelligera, var. *excentrica*, Sidebottom, 1912, etc., LSP. 1912, p. 392, pl. xvi, figs. 5, 6; 1913, p. 175, pl. xv, figs. 30, 31.

Stations 11, 36 (+ T. d. F.).

Two very fine and typical specimens of the round form at Station 36. At Station 11, two specimens of the compressed form; at this Station it occurs in company with our new var. *L. danica* var. *pendulum*, to which it bears considerable resemblance, but differs in the character of the aperture. Sidebottom's variety has a short, thick neck tapering into the body of the shell, whereas *L. danica* var. *pendulum* has a thin neck attached to a globular body, with a thin flange running from the top of the neck to the widest part of the shell.

306. *Lagena stelligera*, var. *nelsoni*, nov. Pl. V, figs. 20–22.

Stations 27, 45, 47, 48, 53.

Test, an irregular compressed oval, with prominent basal ring extending to, and enclosing, a considerable area. At the oral end, and set to one side of the middle axis of the shell, a solid bead of shell-substance projects like a beak and includes the aperture, from which a very long and curving entosolenian tube extends backwards and then downwards almost to the base of the shell. Shell-wall in living specimens extremely glassy and transparent, becoming opalescent in dead shells. The mass of orange-yellow protoplasm is large and often occupies, in the dried state, about a third of the internal cavity.

Dimensions:—Length, ·20–·35 mm., breadth, ·18–·32 mm.

This is a very distinctive and excentric type, occurring at several of the Antarctic Stations, usually one or two specimens at each, but more abundantly

at Station 53. It is difficult to describe, on account of its abnormal features, but may best be compared to the head of a short-billed aquatic bird. We have pleasure in associating the variety with the name of Mr. Nelson, by whom the material was collected.

307. *Lagena crenata*, Parker and Jones.

Lagena crenata, Parker and Jones, 1865, NAAF. p. 420, pl. xviii, fig. 4.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 658.

Station 6.

Three quite typical individuals of the small, thick-walled form.

308. *Lagena exsculpta*, Brady.

Lagena exsculpta, Brady, 1879, etc., RRC. 1881, p. 61 ; 1884, FC. p. 467, pl. lviii, fig. 1 ; pl. lxi, fig. 5.
" " Cushman, 1910, etc., FNP. 1913, p. 28, pl. xiii, fig. 5.

Stations 16–18, 31 (+ T. d. F.).

Occurs only at the three deep-water Stations, and at one other. With one exception all are of the compressed form figured by Brady, and having a slight median keel round the base. This keel, in the specimen from Station 17, is bifid in the centre of the base, and then curves up slightly at diverging angles. At Station 18 a slightly hispid specimen, and at this Station the only non-compressed specimen, which is much longer and narrower than Brady's figure.

309. *Lagena striato-punctata*, Parker and Jones. Pl. VI, figs. 5, 19.

Lagena sulcata, var. *striato-punctata*, Parker and Jones, 1865, NAAF. p. 350, pl. xiii, figs. 25-27.
" *striato-punctata*, Heron-Allen and Earland, 1914, etc., FKA. 1915 p. 660.

Stations 6–10, 16, 17, 36, 38.

Generally distributed but never very abundant. Usually of a long-necked type. At Station 38 the species attains a gigantic size with corresponding development of markings. It becomes obvious that the ribs are solid structures with cells sunk in them at regular intervals throughout their length, the surface being covered with a very delicate outer shell. The structure bears considerable resemblance to that described in our new species, *L. scottii*. At Station 6 an individual was found in which the raised costae were broad and flat and decorated with a double row of pores. At the same Station a *Lagena* was found with a glassy fusiform body, showing bands of denser shell-substances, each band consisting of two parallel rows of dots ; it seems probable that this may be an abnormal *L. striato-punctata*, in which the costae have never been developed.

310. *Lagena desmophora*, Rymer Jones.

Lagena vulgaris, var. *desmophora*, Rymer Jones, 1872, LJS. p. 54, pl. xix, figs. 23, 24.
" *desmophora*, Brady, 1884, FC. p. 468, pl. lviii, figs. 12, 13.
" " Cushman, 1910, etc., FNP. 1913, p. 27, pl. xii, fig. 5 ; pl. xiii, fig. 3.

Station 18.

A single large thick-walled specimen with basal spine. Between each of the primary tubulated costae is a series of three irregularly anastomosing costae. Cushman's 1913 figure (pl. xiii, fig. 3) comes nearer to our specimen than any other published figure.

311. *Lagena forcolata*, Reuss.

Lagena forcolata, Reuss, 1862, FFL. p. 332, pl. v, fig. 65.
.. .. Millett, 1898, etc., FM. 1901, p. 11, pl. i, fig. 15.

Stations 8, 11, 17, 36 (+ D.).

A single specimen at each Station. Typical at Station 36; very coarsely marked at Station 8, each internal chamberlet being recognisable as a distinct square, sealed by the delicate outer shell. The specimen at Station 17 is very weak, the cross bars between the longitudinal ribs forming the internal shell-wall, being almost non-existent. At Stations 8 and 11 specimens with a single spine at the base exactly resembling Sidebottom's fig. 16 (1912, LSP. pl. xvi).

312. *Lagena forcolata*, var. *spinipes*, Sidebottom.

Lagena forcolata, var. *spinipes*, Sidebottom, 1912, etc., LSP. 1912, p. 395, pl. xvi, figs. 18–21; 1913, p. 177.

Stations 17, 18, 36.

Very few individuals, all very much decayed, the double shell-wall having almost entirely disappeared, leaving only the longitudinal ribs, which project round the produced neck as sharp knife-like flanges. They are clearly referable to Sidebottom's fig. 18.

313. *Lagena forcolata*, var. *paradoxa*, Sidebottom.

Lagena forcolata, var. *paradoxa*, Sidebottom, 1912, etc., LSP. 1912, p. 395, pl. xvi, figs. 22, 23; 1913, p. 177, pl. xv, fig. 32.

Station 20.

A single typical specimen. The outer layer of the shell-wall is eroded in places, and indicates that the inner spongy layer is of great thickness. The central cavity cannot occupy more than a half of the bulk of the shell.

314. *Lagena spumosa*, Millett.

Lagena spumosa, Millett, 1898, etc., FM. 1901, p. 9, pl. i, fig. 9.
.. .. Heron-Allen and Earland, 1916, FWS. p. 245, pl. xli, figs. 19, 20.

Stations 16–18, 36 (+ D.).

Confined to the deepest waters; a few good specimens at each Station.

315. *Lagena scottii*, sp. nov. Pl. VI, figs. 3, 4.

Station 45.

Test pyriform, with short stout produced neck, furnished with spiral groovings. Shell-wall, double. The appearance of the outer surface is that of a highly

polished glass bottle, with a fine white netting lining the inner surface. Covered with closely set incisions disposed in a more or less spiral direction down the shell, each incision lying transversely across one of the meshes of the net. This is probably an optical effect only. Seen under a moderately high power the double wall is seen to consist of irregularly hexagonal chambers, lying between the outer and inner shell-walls, and apparently each chamberlet contains a separate vesicle of extremely delicate membrane. We suppose that the reflection and refraction of the light between these different layers is responsible for the appearance of the incisions, for we have been unable to demonstrate any opening in the outer membrane of the wall.

This is a large and very striking organism, differing entirely from any of the other double-walled Lagenae. Unfortunately only two specimens were found.

Dimensions:—Length, ·80–·83 mm.; breadth, ·40–·45 mm.

We have two fossils from Cape Otway (Australia), reported as being Eocene, which probably are referable to this species. The individuals are smaller than the recent type, and have lost the glassy characteristic of the "Terra Nova" specimens, the surface being dull, but the double wall, the hexagonal internal mesh, and the delicate transparency of the outer wall remain obvious. The internal vesicles cannot be demonstrated in these specimens, but there is some tendency to show the "incision" markings of the decoration.

316. *Lagena squamosa* (Montagu). Pl. VI, figs. 1, 2.

Vermiculum squamosum, Montagu, 1803 8, TB. p. 526, pl. xiv, fig. 2.
Lagena squamosa, Cushman, 1910, etc., FNP. 1913, p. 16, pl. vi, fig. 1.

Stations 1, 2, 4–6, 8, 11, 16, 19, 27, 38, 48 (+ K. I., R. d. J.).

The majority of records are from the N.Z. area, where it is common. In addition to the typical form which occurs at Stations 2, 5, 6 and 8, there is a strongly costate thick-shelled form occurring at most of the N.Z. Stations, in which the squamose markings between the costae are variable in position, number and strength; indeed, the most frequent form in the N.Z. area is a costate *Lagena*, which, by the presence of more or less frequent cross markings between the costae, indicates its close relationship to *L. squamosa*. Outside the N.Z. area the records are few and the specimens far from satisfactory. At Station 27 they approach *L. catenulata*, at Station 38 they are typical but weak. At Station 48, however, a single typical individual was found.

317. *Lagena squamoso-sulcata*, sp. nov. Pl. V, figs. 15, 19.

Lagena melo (intermediate var.), Brady, Parker and Jones, 1888, AB. p. 237, pl. xliv, fig. 25.

Stations 27, 38, 48, 50.

Brady, Parker and Jones (*ut supra*) figure a specimen which may be described roughly as *L. squamosa* so far as the oral half of the shell is concerned, and

L. costata as regards the basal half. They do not refer to it in their text, and in the description of the plate it is merely referred to as an intermediate variety of *L. melo*, d'Orb. Identical specimens occur in the Antarctic area, and in these circumstances Brady's figure can no longer be regarded as a freak, but must be given a definite name. The best specimens were from Stations 48 and 50.

Size :— Length, ·45 mm. ; breadth, ·30 mm.

318. *Lagena melo* (d'Orbigny).

Oolina melo, d'Orbigny, 1839, FAM. p. 20, pl. v, fig. 9.
Entosolenia squamosa, var. *catenulata*, Williamson 1848, BSGL. p. 19, pl. ii, fig. 20.
Lagena melo, Millett, 1898, etc., FM. 1901, p. 8.

Station 6.

A few fairly representative specimens and one typical.

319. *Lagena catenulata*, Reuss. Pl. V, figs. 16–18.

[Not *Entosolenia squamosa*, var. *catenulata*, Williamson, 1848, BSGL. p. 19, pl. ii, fig. 20.]
Lagena catenulata, Reuss, 1862, FFL. p. 332, pl. vi, fig. 75 (only).
" " Cushman, 1910, etc., FNP. 1913, p. 18, pl. vii, figs. 1, 2.

Stations 16, 18, 31, 36.

Williamson's variety of *L. squamosa*, var. *catenulata*—and his figure, agree with *L. melo*, d'Orbigny. His authorship therefore lapses in favour of Reuss, whose fig. 75 of *L. catenulata*, Williamson, represents a different test, which is the one now before us. Reuss's figure represents a shell with a limited number of costae (12–14 in number) between which are a limited number of depressed cross-bars.

Reuss's form is quite distinctive : it differs from *L. melo* in the depression of the cross-bars and their fewness, and from *L. squamosa* in the rectangular spaces thus produced. Judging by the "Terra Nova" material, *L. catenulata* replaces *L. squamosa* in deep-water. Very fine and typical specimens occur at Stations 16 and 18, less strongly marked individuals at Stations 31 and 36.

320. *Lagena reticulata* (Macgillivray).

Lagenula reticulata, Macgillivray, 1843, HMAA. p. 38.
Lagena " Heron-Allen and Earland, 1911, etc., FKA. 1915, p. 656.

Stations 6, 16, 31.

Rare everywhere, fine and typical at Station 6. Large and weak at the other stations.

321. *Lagena hexagona* (Williamson).

Entosolenia squamosa, var. *hexagona*, Williamson, 1848, BSGL. p. 20, pl. ii, fig. 23.
Lagena hexagona, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 656.

Stations 2, 6, 9, 10, 11, 16, 18,–20, 22, 23, 27, 31, 36 (+ R. d. J., D.).

Generally distributed, but not observed south of Station 36. There is the usual wide range of variation, both in form of test, prolongation of neck, and

the size and regularity of the hexagonal markings. It reaches its finest development in the deep-water Stations, between Stations 16 and 22, where it attains considerable size, and the hexagonal reticulation is large and strongly developed. The best individuals occur at Stations 23, 27 and 31.

322. *Lagena seminuda*, Brady.

Lagena seminuda, Brady, 1884, FC. p. 472, pl. lviii, fig. 34.
,, ,, Jones, Parker and Brady, 1866, etc., MFC. 1895, p. 194, pl. vi, fig. 8.

Station 17.

Two very fine specimens.

323. *Lagena protea*, Chaster.

Lagena protea, Chaster, 1892, FS. p. 62, pl. i, fig. 14.
,, ,, Sidebottom, 1904, etc., RFD, 1906, p. 15, pl. ii, fig. 18; 1912, etc., LSP, 1912, p. 427; 1913, p. 203.
,, ,, Heron-Allen and Earland, 1913, CI, p. 74, pl. vii, figs. 19, 20.
,, *hispidipholus*, Pearcey, 1914, SNA, p. 1,020, pl. ii, figs. 11–13.

Station 53.

Two large specimens from almost farthest South, one presenting a single aperture, the other several, surface comparatively smooth. While generally agreeing with Chaster's opinion quoted by Sidebottom, *ut supra* (1912, p. 427), we believe that *L. protea*, like many other Lagenae, has a tendency to produce a secondary aperture or apertures. The species was referred to *Ramulina* by Jones and Chapman (J. & C. 1896–8, FPR. 1898, p. 342, fig. 11), but its referability to *Lagena* was fully discussed in the letter of Chaster to Sidebottom, cited in his paper (*ut supra*). We have no hesitation in ascribing Pearcey's *L. hispidipholus* to this form.

324. *Lagena laevigata* (Reuss).

Fissurina laevigata, Reuss, 1849–50, FOT. p. 366, pl. i (xlvi), fig. 1.
Lagena ,, Heron-Allen and Earland, 1914, etc., FKA, 1915, p. 661.

Stations 2, 3, 5, 6–12, 14, 16–20, 23, 26, 27, 29, 31, 36–38, 46–48, 53–55 (+ T. d. F., R. d. J., D.).

Almost universally distributed, but attaining its best development at the deep-water Stations. In addition to the usual type, two punctate or coarsely perforate, and finely perforate forms occur. The coarsely punctate form is most typical in the N.Z. area (Stations 2 and 3), but it occurs also at Station 53. The finely punctate form is more abundant in the deep-water Stations, but also occurs in the circum-polar Stations, especially Station 53. There is the usual wide variation in the comparative length and breadth of the shell, exceptionally long specimens at Station 26.

[Arenaceous isomorph, *Reophax ampullacea*, Brady (*pars*) = *R. lageniformis*, Chap. (C. 1891, etc., GF. 1892, p. 1, pl. v, fig. 1).]

325. *Lagena ventricosa*, Silvestri.

Lagena ventricosa, Silvestri, 1903, PM. p. 10, figs. 6, *a–c*.
,, ,, Chapman, 1910, FOF. p. 110, pl. liv, fig. 9.

Stations 20, 27.

This hooded and swollen form of *L. laevigata* occurs at these Stations. It may possibly have been overlooked at other Stations.

326. *Lagena acuta* (Reuss).

Fissurina acuta, Reuss, 1858, FP. p. 434; and Reuss, 1862, FFL. p. 340, pl. vii, figs. 90, 91.
Lagena acuta, Heron-Allen and Earland, 1914, etc.; FKA. 1915, p. 661.

Stations 6, 9, 16, 18, 19, 22, 23, 36, 55 (+ D.).

Rare, but extending over all the areas. As a rule quite typical, the best specimens at Station 36. At Station 23 the type is long, at Station 16, in addition to typical forms, a thick-walled, coarsely punctate form occurs.

327. *Lagena staphyllearia* (Schwager).

Fissurina staphyllearia, Schwager, 1866, FKN. p. 209, pl. v, fig. 24.
Lagena ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 664.

Stations 8, 11, 17, 19, 23, 26, 27, 31, 36 (+ K. I., D.).

Occurs in all three areas, but in all sparingly, and not south of Station 36. The spinous development is rather poor and as a rule rarely exceeding three spines, situated at equal spaces at the aboral edge. At Station 8 the specimens are two-spined, and also at Station 23, where the spines are very long. At Station 36 the spines are long and the surface of the test shows fine striation.

L. staphyllearia does not appear to be more than a spinous form of several closely-allied Lagenae, viz., *laevigata*, *marginata* and *quadricostulata*. All the specimens might be so described.

328. *Lagena unguiculata*, Brady.

Lagena unguiculata, Brady, 1879, etc., RRC. 1881, p. 61; 1884, FC. p. 474, pl. lix, fig. 12.
,, ,, Sidebottom, 1912, etc., LSP 1912, p. 104, pl. xvii, fig. 25; 1913, p. 185.

Station 27.

Two good and typical specimens.

329. *Lagena lucida* (Williamson).

Entosolenia marginata, var. *lucida*, Williamson, 1858, RFGB. p. 10, pl. i, figs. 22, 23.
Lagena lucida, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 661.

Stations 6, 8, 10, 11, 27, 47 (+ R. d. J.).

Very sparingly distributed and, with the exception of two Stations, confined to the N.Z. area, where it is frequent and very typical, especially at Station 6. The Antarctic specimens are smaller, less distinctive and very thin walled.

330. *Lagena annectens*, Burrows and Holland.

Lagena annectens, Burrows and Holland, in Jones, Parker and Brady, 1866, etc., MFC. 1895, p. 203, pl. vii, fig. 11.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 662.

Stations 1–3, 6, 8, 10–12, 31, 47 (+ D.).

Occurs in the N.Z. and Antarctic areas, but nowhere in deep water, or in any abundance. The best at Station 6, where a variety with clouded spaces in the clear shell-substance occurs. A pedunculate specimen at Station 10. Good individuals at Station 31 in the Antarctic.

331. *Lagena fasciata* (Egger).

Oolina fasciata, Egger, 1857, MSO. p. 270, pl. i (v), figs. 12–15.
Lagena " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 662.

Stations 6, 10.

Rare, but good specimens at Station 10.

332. *Lagena fasciata*, var. *faba*, Balkwill and Millett.

Lagena faba, Balkwill and Millett, 1884, FG. p. 81, pl. ii, fig. 10.
Lagena fasciata, var. *faba*, Heron-Allen and Earland, 1913, CI. p. 81.

Stations 2, 6, 27.

Sparingly represented but typical. At Station 6 a large and abnormal specimen characterized by the broad and turgid aboral extremity sloping away towards the aperture, suggesting a hand-bag.

333. *Lagena reniformis*, Sidebottom.

Lagena reniformis, Sidebottom, 1912, etc., LSP. 1913, p. 204, pl. xviii, figs. 14, 15.
" " Heron-Allen and Earland, 1916, FWS. p. 255, pl. xli, figs. 30–31.

Stations 8, 38.

A single typical specimen at Station 8 and a very large and fine one at Station 38.

334. *Lagena malcomsonii*, Wright.

Lagena laevigata, var. *malcomsonii*, Wright, 1910-11, BCNI. p. 4, pl. i, figs. 1, 2.
Lagena malcomsonii, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 662.

Stations 2, 3, 5, 6, 8, 17.

With the exception of one typical specimen from deep water at Station 17, all the specimens are from the N.Z. area, where they are typical but never frequent.

335. *Lagena quadrata* (Williamson).

Entosolenia marginata, var. *quadrata*, Williamson, 1858, RFGB. p. 11, pl. i, fig. 27.
Lagena quadrata, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 662.

Stations 2, 3, 6, 8.

Confined to the N.Z. area. Frequent and typical, the best at Station 6. The marginal keel is very often thick. At Station 8, in addition to the type, a variety occurs in which the central area is raised abruptly so that the marginal edge projects as a sharp flange round an oblong box. It is very near the form recorded by Millett from the Malay Archipelago (FM. 1901, pl. viii, fig. 18). At Station 6 the very long parallel-sided type figured by Sidebottom (S. 1910, RFBP. p. 18, pl. ii, fig. 8), from Palermo was found.

336. *Lagena forficula*, Heron-Allen and Earland.

Lagena forficula, Heron-Allen and Earland, 1913, CL. p. 87, pl. vi, fig. 11.

Station 36.

Two specimens from this Station. The remarkable depth (2,216 fms.) contrasts strongly with the shallow water British record.

337. *Lagena schlichti* (Silvestri).

Fissurina carinata (pars), Reuss, 1870, FSP. p. 469. (See Schlicht, 1870, FSP. pl. v, figs. 1–3.)
Fissurina schlichti, Silvestri, 1902, LMT. p. 143. Text-figs. 9–11.
Lagena ,, Chapman, 1909, SNZ. p. 337, pl. xv, figs. 7, *a*, *b*.

Stations 6, 9, 10, 12, 16–18, 20.

Typical and often abundant in the N.Z. and deep-water areas, especially at Stations 6, 10, 12 and 17.

338. *Lagena marginata* (Walker and Boys). Pl. V, fig. 23.

Serpula (*Lagena*) *marginata*, Walker and Boys, 1784, TMR. p. 2, pl. i, fig. 7.
Lagena marginata, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 663.

Stations 2, 3, 5, 6, 7, 10 12, 17 19, 22, 23, 26, 27, 31, 36, 38, 45, 48, 53, 55 (+ K.I., D.).

Universally distributed. In the N.Z. area most abundant at Station 6, where every variation in the rotundity of the test and the breadth of the keel occurs. In the deep-water area, best at Station 17, characterized by both broad and medium keels, but very good at all the deep-water Stations. In the Antarctic, best at Station 27, where the specimens are abundant and varied, including large individuals, without keel; these are also noted from Kerguelen Island in our Appendix B. Trigonal and quadrigonal specimens at Station 27. At Station 31 very good specimens, but many showing clearly parasitic borings. At Station 36 one broken specimen of enormous size; at Station 38 the specimens are all very large with narrow keels. In the circum-polar Stations all the individuals are comparatively small but typical.

At Station 36 a specimen ·12 mm. long is recorded (pl. v, fig. 23) exhibiting a broad keel broken up into a serrate edge extending over the basal half of the

shell only, the rest of the edge being rounded. We figured a rather similar specimen from the West of Scotland, but in that case the keel extended unbroken round the remainder of the shell (H.-A. & E. 1916, FWS. p. 251, pl. xli. fig. 26).

[Arenaceous isomorph of keel-less variety, *Reophax ampullacea*, Brady (*pars*) = *R. lenticularis*, Gryzb. 1895, *R. grandis*, Gryzb. 1897 and *R. placenta*, Gryzb. 1897.]

339. *Lagena marginata*, var. *fissa*, nov. Pl. V, figs. 24, 25.

Stations 27, 31.

This is an interesting variety in which the keel, rapidly increasing in breadth over the basal quadrant of the shell, is deflected just before reaching the aboral extremity and as rapidly decreases in breadth and vanishes, with the result that the extreme aboral end of the shell shows two keels somewhat widely separated. The figure will explain the structure.

Size :—Length, ·45 mm.; breadth ·40 mm.; thickness, ·22 mm.

340. *Lagena marginata*, var. *raricostata*, Sidebottom.

Lagena marginata, var. *raricostata*, Sidebottom, 1912, etc., LSP. 1912, p. 108, pl. xviii, figs. 8, 9.

Station 29.

A single typical specimen.

341. *Lagena marginata*, var. *semimarginata*, Reuss.

Lagena marginata, var. *semimarginata*, Reuss, 1870, FSP. p. 468; Schlicht, 1870, FSP. p. 11, pl. iv, figs. 4–6, 10–12.
" " " " Brady, 1884, FC. p. 477, pl. lix, figs. 17–19.
" " " " Millett, 1898, etc., FM. 1901, p. 619, pl. xiv, fig. 1.

Stations 11, 16, 19, 27.

Very rare but quite typical, the best at Station 19 in deep water, almost equally good at Station 11 (N.Z.).

342. *Lagena marginata*, var. *inaequilateralis*, Wright.

Lagena marginata, var. *inaequilateralis*, Wright, 1885 6, BLP. p. 321, pl. xxvi. fig. 10.
" " " " Sidebottom, 1904, etc., RFD. 1906, p. 10, pl. ii, fig. 6.

Station 6.

Three typical specimens.

343. *Lagena unguis*, Heron-Allen and Earland.

Lagena unguis, Heron-Allen and Earland, 1913, CI. p. 86, pl. vii, figs. 1–3; 1913, FNS. p. 135; 1916, FSC. p. 46.

Station 2.

A single specimen, typical.

344. *Lagena marginato-perforata*, Seguenza. Pl. VI, figs. 8, 9.

Lagena marginato-perforata, Seguenza, 1879-80, FTR. p. 332, pl. xvii, fig. 34.
" " " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 663, pl. L, figs. 24-30.

Stations 6, 10, 11, 27, 31.

Not infrequent in the N.Z. area, and very typical at Station 6. Less common, but typical, in the deep-water and Antarctic. At Station 10, the type is superseded by a large and striking variety characterized by a thick oral extremity with faint costal markings which die out over the surface of the shell but reappear at the base, where there is a raised semilunar ridge running concentrically with the basal edge. This form also occurs at Station 11, but is less strikingly developed, and is accompanied by the type.

345. *Lagena seminiformis*, Schwager.

Lagena seminiformis, Schwager, 1866, FKN. p. 208, pl. v, fig. 21.
" " Brady, 1851, FC. p. 478, pl. lix, figs. 28–30.
" *marginata*, var. *seminiformis*, Millett, 1898, etc., FM. 1901, p. 620, pl. xiv, fig. 3.

Station 6.

One rather weak specimen.

346. *Lagena lagenoides* (Williamson).

Entosolenia marginata, var. *lagenoides*, Williamson, 1858, RFGB. p. 11, pl. i, figs. 25, 26.
Lagena lagenoides, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 665.

Stations 5, 6, 10, 16, 17, 18.

Confined to the N.Z. area and deep water. Very rare but typical at Stations 5, 6 and 10. At Stations 16 and 18 specimens are very large and beautifully developed. At Station 16 a trigonal specimen, and a single individual of a very fine delicate type. At Station 17 all are small and delicate and pass imperceptibly into the var. *tenuistriata*. At this Station a single small specimen showing a raised ridge forming a horseshoe at the aboral end of the shell.

347. *Lagena lagenoides*, var. *tenuistriata*, Brady.

Lagena tubulifera, var. *tenuistriata*, Brady, 1879, etc., RRC. 1881, p. 61.
" *lagenoides* " " Brady, 1884, FC. p. 479, pl. lx, figs. 11, 15, 16.
" " " " Cushman, 1910, etc., FNP. 1913, p. 39, pl. xvi, fig. 3.

Stations 8, 10, 17, 22.

The distribution is similar to that of the type but it does not always occur at the same Stations. All the specimens are small, except at Stations 22 and 23, where they are large, but are otherwise dissimilar, the markings being very coarse at Station 22 and typically delicate at Station 23. At Station 10 a small trigonal specimen.

At Station 8 a few specimens exhibiting a lateral twist in the long axis of the shell, combined with a certain duplication and overlapping of the wing at the middle of the base, comparable with our *L. marginata*, var. *fissa* in its most extreme development. The specimens may be compared with Silvestri's figure of *Fissurina radiata*, Seg. (S. 1902, LMT. p. 145, figs. 20–22), but Silvestri's figure has little or no resemblance to Seguenza's original (S. 1862, FMMM. p. 70, pl. ii. figs. 42, 43) which represents *L. lagenoides* of a normal type. Much more closely allied to our specimens, and perhaps identical, is the form figured by Rymer Jones (J. 1872, LJS. p. 59, pl. xix, fig. 42) under the name *L. vulgaris*, sub-var. *spinoso-marginata*. His figure is drawn from a broken specimen, but the shading appears to indicate the twist of the shell and the duplication of the basal keel, although he makes no reference to either feature in the text.

348. *Lagena lagenoides*, var. *nuda*, Chapman.

Lagena lagenoides, var. *nuda*, Chapman, 1909, SNZ. p. 338, pl. xv, fig. 9.

Stations 16, 18, 20.

Excellent representative specimens from each Station. The shell-substance in all cases is white and opaque, but indicates no corrosion. The relationship to *L. lagenoides* does not appear to be very clear except as regards the general similarity of outline; we should have been inclined to regard it as more nearly allied to *L. bicarinata*. Some of the specimens are feebly pedunculate.

349. *Lagena ornata* (Williamson).

Entosolenia marginata, var. *ornata*, Williamson 1858 RFGB. p. 11, pl. i, fig. 21.
Lagena ornata, Heron-Allen and Earland, 1913, CI. p. 88, pl. vii, fig. 8.

Station 2.

A single coarse, thick-shelled specimen.

350. *Lagena formosa*, Schwager. Pl. VI, figs. 24, 25.

Lagena formosa, Schwager, 1866, FKN. p. 206, pl. iv, figs. 19, *a d*, pl. vii, fig. 1.
" " Millett, 1898, etc., FM. 1901, p. 624, pl. xiv, figs. 10–12.
" " Sidebottom, 1912, etc., LSP. 1912, p. 414, pl. xix, figs. 6–9; 1913, p. 191, pl. xvii, figs. 3–8.

Stations 27, 36.

Very rare. Nearly all the specimens resemble the type figured by Sidebottom (1912, pl. xix, fig. 6), but at Station 27 there is a specimen (Pl. VI, figs. 24, 25), which probably represents his later figure (1913, pl. xvii, fig. 6) in the perfect condition. The neck is very long, nearly equal to the length of the shell with an everted lip. The central area is marked, as in Sidebottom's figure, and here the shell-wall is apparently thickened. The tubules shown round the edge of Sidebottom's figure are not indicated in our specimen, but the whole of the thick marginal edge, which projects more than in Sidebottom's figure, is filled with dense, sponge-like shell-structure.

351. *Lagena formosa*, var. *comata*, Brady.

Lagena formosa, var. *comata*, Brady, 1884, FC. p. 480, pl. lx, fig. 22.
" " " " Cushman, 1910, etc., FNP. 1913, p. 42, pl. xi, fig. 8.

Stations 22, 23, 53.

Represented by many magnificent specimens at each Station, that from Station 53 being smaller than the deep-water specimens.

352. *Lagena formosa*, var. *favosa*, Brady.

Lagena formosa, var. *favosa*, Brady, 1884, FC. p. 480, pl. lx, fig. 21.
" " " " Cushman, 1910, etc., FNP. p. 41, pl. xi, fig. 7.

Station 16.

Represented by the oral portions only of what must have been very large and finely marked individuals, clearly identifiable by the characteristic markings of the wing.

353. *Lagena quadrangularis*, Brady.

Lagena quadrangularis, Brady, 1884, FC. p. 483, pl. cxiv, fig. 11.
" " Millett, 1898, etc., FM. 1901, p. 625, pl. xiv, fig. 17.

Stations 18, 36.

One specimen, characterized by extreme length and narrowness of the shell, which is acutely pointed at both ends, at Station 18, and several smaller ones of the same type at Station 36. The cross section of our specimens is a square with hollowed sides, instead of an oblong as in Brady's type.

354. *Lagena quinqueladera*, Brady.

Lagena quinqueladera, Brady, 1879, etc., RRC. 1881, p. 60; 1884, FC. p. 484, pl. lxi, figs. 15, 16.
" " Millett, 1898, etc., FM. 1901, p. 493, pl. viii, fig. 11.

Stations 18, 20, 22.

Excellent and typical specimens.

355. *Lagena rizzae* (Seguenza).

Fissurina rizzae, Seguenza, 1862, FMMM. p. 72, pl. ii, fig. 50.
Lagena " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 666.

Stations 2, 6.

Very rare.

356. *Lagena bicarinata* (Terquem).

Fissurina bicarinata, Terquem, 1882, FEP. p. 31, pl. i (ix), fig. 24.
Lagena " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 665.

Stations 2, 3, 6, 9, 11, 16, 18, 22, 23, 27, 29, 36.

Widely but sparingly distributed, presenting a great range within its specific character. The best at Stations 6, 11, 22, 23. At Station 3 a very long type with parallel sides occurs.

At Station 2 a remarkable specimen was found, heart-shaped, with an entosolenian aperture at each extremity. The surfaces plane, slightly sloping from the thickest extremity or point of the heart to the base. The principal aperture appears to be at the pointed end.

357. *Lagena bicarinata*, var. *villosa*, nov. Pl. VI., figs. 10–12.

Stations 2, 3, 6.

Characters similar to the type, but the marginal edges are thickened with shell-substance, granular in structure, giving the appearance of a fur trimming round a clear test. Confined to the N.Z. area and rare. The best specimens at Station 6.

Size :—Length, ·23 mm. ; breadth, ·20 mm. ; thickness, ·12 mm.

358. *Lagena bicarinata*, var. *spinigera*, nov. Pl. VI, figs. 6, 7.

Lagena bicarinata, Sidebottom, 1912, etc., LSP. 1912, p. 419, pl. xix, fig. 27.

Stations 17, 23.

One specimen at each Station referable to Sidebottom's form as referred to above, characterized by the weakly developed and widely separated carinae and the presence of a single conspicuous basal spine, to which no reference is made in his text, though it is clearly indicated in the drawing. The spine in our specimens are very much more developed than is shown in his figure.

Size :—Total length, ·27 mm. (including spine, ·03 mm.) ; breadth, ·09 mm.

359. *Lagena enderbiensis*, Chapman.

Lagena enderbiensis, Chapman, 1909, SNZ. p. 339, pl. xvi, figs. 1, *a*, *b*.

Stations 2, 6.

Fairly frequent. This appears to be one of the typical N.Z. Foraminifera.

360. *Lagena orbignyana* (Seguenza.)

Fissurina orbignyana, Seguenza, 1862, FMMM. p. 66, pl. ii, figs. 25, 26.
Lagena ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 666.

Stations 2, 3, 5–8, 10, 11, 16–18, 22, 27, 36, 45, 48.

Universally distributed, most frequent in the N.Z. area, where two distinct types occur at most of the Stations, one being much longer than the other, and usually with poorly developed keels, forming a variety intermediate between Chapman's *L. enderbyensis* and the type. At Station 6 in the N.Z. area specimens occur of a quadrate circular type, with spinous base, referable to Millett's variety, *calcar* (M., 1885, etc., St. E. 1898, p. 175, pl. 0), but differing from his specimens in the absence of the produced neck, as figured in the original drawing, and in the more quadrate outline of the test, as figured in his Malay paper (M., 1898, etc., F.M. 1901, p. 626, pl. xiv, fig. 18), and figured by Sidebottom, without a varietal name, from the Pacific (S., 1912, etc., LSP., 1912, p. 416, pl. xix, fig. 14). The finest development is attained in the deep-water Stations, notably Stations 16–18, where

they are large, often furnished with very wide median carinæ, and at Stations 17 and 18, passing imperceptibly into var. *coronata*, Sidebottom. Excellent examples with wide carinae occur as far south as Stations 45 and 48.

361. *Lagena orbignyana*, var. *selseyensis*, Heron-Allen and Earland.

Lagena orbignyana, var. *selseyensis*, Heron-Allen and Earland, 1908, etc., SB. 1909, p. 426, pl. xvii, figs. 1, 2.
" " " " Halkyard, 1919, BMB. p. 63.

Stations 3, 6.

The elongate type referred to in our note on *L. orbignyana* reaches its final development in specimens occurring at these Stations, and referable to our variety *ut supra*.

362. *Lagena orbignyana*, var. *walleriana*, Wright.

Lagena orbignyana, var. *walleriana*, Wright, 1886, SWI. p. 611; and 1891, SWI. p. 481, pl. xx, fig. 8.
" " " " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 666, pl. L, figs. 31-36.

Stations 3, 6, 7, 32.

Very rare, single individuals only at each Station. Excellent at Stations 7 and 32.

363. *Lagena orbignyana*, var. *baccata*, nov. Pl. VI, figs. 15, 16.

Stations 4, 5, 6, 8.

Test circular in outline, consisting of a circular chamber with short produced neck, flush with the extremity of which the median carina extends without variation in width right round the shell. The superior and inferior faces of the chamber are either parallel or but slightly convex, and its edge is furnished with a thickened margin forming the outer carina of the test, this carina being broken up at regular intervals all round by constrictions which give a beaded outline to a complete ring concentric with the centre of the test.

Dimensions:—·20 mm. in diameter; ·07 mm. in thickness.

This very characteristic and pretty little form is confined to the N.Z. area, where it occurs sparingly at the Stations.

364. *Lagena orbignyana*, var. *concentrica*, Sidebottom.

Lagena orbignyana, var. *concentrica*, Sidebottom, 1912, etc., LSP. 1912, p. 417, pl. xix, fig. 23.
" " " " Cushman, 1910, etc., FNP. 1913, p. 44, pl. xix, fig. 2.

Station 36.

A few good specimens. The median carina is wider and better developed than in Sidebottom's figure.

365. *Lagena orbignyana*, var. *coronata*, Sidebottom.

Lagena orbignyana, var. *coronata*, Sidebottom, 1912, etc., LSP. 1912, p. 416, pl. xix, fig. 15.
„ „ „ „ Cushman, 1910, etc., FNP. 1913, p. 43, pl. xx, fig. 3.

Stations 16, 17, 36.

Confined to deep-water Stations. Frequent and typical at Station 16. At Station 36 the variety is represented by a single very fine individual, in which the carinae are interrupted in the middle of the base, and replaced by a tuft of fine spines.

366. *Lagena orbignyana*, var. *unicostata*, Sidebottom.

Lagena orbignyana, var. *unicostata*, Sidebottom, 1912, etc., LSP. 1912, p. 417, pl. xix, fig. 22.

Stations 17, 29.

A number of specimens with very variable minor features can, perhaps, be best referred to this variety. The basal notch in the carina indicated in Sidebottom's figure is generally extremely strong; in fact, all three keels are thus cut away in some specimens at the actual base of the shell. The central costa which gives it the varietal name is represented in different specimens by one, two, or three bars. Occasionally it is reduced almost to the clear bead of var. *walleriana*, indicating a transition stage between many forms of the *orbignyana* type.

367. *Lagena orbignyana*, var. *yokoyamae*, Millett. Pl. VI, figs. 17, 18.

Lagena yokoyamae, Millett, 1885, etc., St. E. 1894, p. 657 (no fig.).

Stations 1–3, 6.

Differing from the normal *L. orbignyana* in the thick, ill-developed median carina, in the development on the surfaces of the shell, of a series of ridges extending from the margin of the clear convex faces to the inner surface of the raised outer carinae. The marginal fringe of the chamber is by this means cut up into a series of radiating depressed chamberlets, which, in the majority of specimens, take the form of sunken pits separated by narrow high ridges. At Station 3, however, a number of specimens show these radial chamberlets to be covered with a superficial enclosing wall continuous with the outer test of the chamber, so that each becomes a sealed cavity, and this may be, possibly is, the normal type, the enclosing surface-membrane being sufficiently thin to become easily absorbed or destroyed during the life-time of the animal, and so forming the sunken "trenches" or pits.

Dimensions:—Length, ·30–·35 mm.; breadth, ·22–·23 mm.

This very striking form is confined to the N.Z. area, where it is comparatively frequent at Stations 2 and 3.

These specimens appear to be closely allied to, if not identical with, the

form referred to by Millett in his third St. Erth paper (*ut supra*). He then expressed the intention of describing and figuring it under the specific name *L. yokoyamae* in a forthcoming paper on the Foraminifera of the shore-sands of Misaki, Japan. Millett's collection of specimens and papers passed into our hands on his death. We have been unable to locate any specimens, and the notes are of a fragmentary nature, that on this variety being merely the paragraph published in the St. Erth paper (*ut supra*). But there is a drawing of the species among his papers which identifies it with our N.Z. specimens, to which we give Millett's specific name, reducing it to a varietal form of *L. orbignyana*.

368. *Lagena scarabaeus*, sp. nov. Pl. VI, figs. 20–23.

Stations 2, 3, 5, 6.

Test oblong with rounded off corners; entosolenian. Median carina but slightly developed. The two faces of the test, which are flattened and approximately parallel, are marked by a series of concentric ridges conforming to the outline of the test. The number of these ridges varies, but in the best-marked individuals there are three or more confocal rings, fairly widely separated, the inner ring being divided in its long axis by a raised bar. In other specimens, although the number of rings is no greater, they are set much closer together so as to present a considerable central space which, instead of having the transverse bar, is more or less roughly granular with upstanding shell-substance.

Dimensions:—Length, ·30–·45 mm.; breadth, ·22–·30 mm.; thickness, ·12 mm.

Confined to the N.Z. area and comparatively common at the Stations. The best series from Station 5. The species is very distinctive, and is remarkably suggestive of an Egyptian Scarab. The general appearance is very like Side bottom's figure of his var. *L. auriculata*, var. *clypeata* (S. 1912, etc., LSP. 1913, p. 199, pl. xviii, fig. 5) but none of the N.Z. specimens exhibits any trace of the basal loops distinguishing *L. auriculata*.

Nearly all the specimens are fossils.

369. *Lagena lacunata*, Burrows and Holland.

Lagena castrensis, Brady (*non* Schwager), Brady, 1884, FC. p. 485, pl. lx, figs. 1, 2 and (?) 3
" *lacunata*, Heron-Allen and Earland, 1916, etc., FKA. 1915, p. 668.

Stations 5, 6.

Very few typical specimens. In the majority of cases the lacunæ in the shell-wall are represented by opaque inclusions of a milky-white shell-substance contrasting with the hyaline surface of the test.

370. *Lagena castrensis*, Schwager.

Lagena castrensis, Schwager, 1866, FKN. p. 208, pl. v, fig. 22.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 667.

Stations, 2, 6, 10.

A few specimens only from the N.Z. area, the best from Station 6.

371. *Lagena pulchella*, Brady.

Lagena pulchella, Brady, 1866, Rep. Brit. Ass. (1867), p. 70.
,, ,, Brady, 1870, FTR. p. 294, pl. xii, fig. 1, *a*, *b*.
,, ,, Balkwill and Wright, 1885, DIS. p. 342, pl. xii, fig. 19.

Stations 2, 3, 6.

Like *L. clathrata*, from which it differs by its branching costae, this form is confined to the N.Z. area, where it is rare. The best specimens at Station 6.

372. *Lagena pulchella*, var. *hexagona*, Heron-Allen and Earland.

Lagena pulchella, var. *hexagona*, Heron-Allen and Earland, 1916, FWS. p. 254, pl. xli, fig. 27.

Station 6.

At this Station several specimens of this very ornate variety.

373. *Lagena clathrata*, Brady.

Lagena clathrata, Brady, 1884, FC. p. 485, pl. lx, fig. 4.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 668.

Stations 2, 3, 5–8, 10–12, 36.

This is one of the most characteristic N.Z. Foraminifera, and, with the exception of a single specimen, all our records are confined to that area. It is, moreover, very variable, the lines of variation developing in the direction of the suppression of the keel, and the number of costae on the faces of the test. Individuals with weak development of the keel have as a rule an excessive number of costae on the face of the shell, while those with a strongly-developed median carina are usually furnished with a very limited number of strong costae. Specimens of this type have been noticed with as few as three prominent costae, and the number rarely exceeds seven when the costae are strong. At Station 5 a specimen with a long produced neck, the only one found in N.Z., and closely resembling the only specimen recorded outside the N.Z. area, which was from Station 36 (2,216 fms.), the surface of which is very finely costate. The best N.Z. Stations are Stations 6, 7, and 10.

374. *Lagena clypeato-marginata*, var. *crassa*, Sidebottom.

Lagena vulgaris, var. *clypeato-marginata*, Rymer Jones, 1872, LJS. p. 58, pl. xix, fig. 37.
,, *clypeato-marginata*, Sidebottom, 1912, etc., LSP. 1912, p. 425, pl. xxi, fig. 6.

Stations 10, 11.

Moderately abundant at both Stations. Many of the specimens agree entirely with Sidebottom's description and figure, in others the markings, which he says "are sometimes arranged as lines," have developed into feeble costae. The species is referable to the *L. auriculata* group, some of the specimens showing well-developed loops at the basal edges.

375. *Lagena danica*, Madsen.

Lagena danica, Madsen, 1895, FDH. p. 196, pl. 0, fig. 4.
.. .. Goës, 1896, DOA. p. 53, pl. v, figs. 11, 12.

Stations 6, 8, 17, 18.

Very good and typical specimens from deep water Stations 17, 18; less distinctive from Stations 6 and 8 in the N.Z. area.

376. *Lagena danica*, var. *pendulum*, nov. Pl. VI, figs. 13, 14.

Stations 10, 11.

Differs from the type by the presence of a comparatively long neck joined to the body of the shell by a broad wing. The body of the test increases in thickness towards the aboral extremity. At the widest point in its diameter, the carina starting from the neck divides into a thickened rim, surrounding a wide area at the base of the shell as in the type. The shape suggests the "bob" of a pendulum. Not uncommon at the Stations where it occurs, but at these Stations the type is absent.

Size: -Length, ·30–·35 mm.; breadth, ·20 mm.; maximum thickness, ·18 mm.; thickness at base, ·10 mm.

377. *Lagena fimbriata*, Brady.

Lagena fimbriata, Brady, 1879, etc., RRC. 1881, p. 61; 1884, FC. p. 486, pl. lx, figs. 26-28.
.. *orbignyana*,? Sidebottom, 1912, etc., LSP. 1912, p. 418, pl. xxi, fig. 15.

Stations 10, 16, 27, 36.

Singularly rare, represented as a rule by one specimen at each Station. At Station 27 were two large typical individuals. At Station 36 a number of exceedingly delicate spines protrude from the enclosed basal portion.

378. *Lagena fimbriata*, var. *occlusa*, Sidebottom.

Lagena fimbriata, var. *occlusa*, Sidebottom, 1912, etc., LSP. 1912, p. 423, pl. xx, figs. 27, 28; 1913, p. 202.
.. .., Heron-Allen and Earland, 1913, CI. p. 90, pl. vii, fig. 15.

Stations 15, 18.

A single specimen at each Station.

379. *Lagena auriculata*, Brady. Pl. VI, fig. 26.

Lagena auriculata, Brady, 1879, etc., RRC. 1881, p. 61; 1884, FC. p. 487, pl. lx, figs. 29, etc.
.. .. Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 669.

Stations 9, 10, 11, 16, 17, 26 (+ K. I.).

Confined to N.Z. and deep water, and the specimens are, as a rule, small, but distinctive. At Station 9 a single individual (·16 mm. long), marked by the pressure of distinct tubular loops at the four corners of a somewhat quadrate

test. The aperture appears to occupy the whole of the space between the oral loops.

380. *Lagena auriculata*, var. *quadri-auriculata*, nov. Pl. VI, fig. 27.

Station 16.

"A single specimen, resembling Sidebottom's figure (LSP. 1912, etc., 1912, p. 422, pl. xx, fig. 21) of var. *costata*, except for the fact that there are two separate pairs of loops on each side of the base, connected by the extended wing. This clearly proves that it is more closely related to *L. auriculata* (characterized by two loops only) than to *L. alveolata*, which normally has four loops divided into two pairs by a keel. At the upper edge of the shell, below the base of the neck, a pair of tubules similar to the basal tubes also occurs.

Size :—Length (without neck), ·18 mm. ; maximum breadth, ·12 mm.

381. *Lagena alveolata*, Brady.

Stations 16, 18, 20, 22, 23, 36 (+ T. d. F.).

Lagena alveolata, Brady, 1884, FC. p. 487, pl. lx, figs. 30, 32.
,, ,, Cushman, 1910, etc., FNP. 1913, p. 33, pl. xviii, fig. 1.

Confined to deep-water Stations. Very good and typical at Stations 20 and 36.

382. *Lagena alveolata*, var. *substriata*, Brady.

Lagena alveolata, var. *substriata*, Brady, 1879, etc., RRC. 1881, p. 61; 1884, FC. p. 488, pl. lx, fig. 34.
,, ,, ,, ,, Cushman, 1910, etc., FNP. 1913, p. 34, pl. xviii, fig. 5.

Stations 18, 19, 20, 22 (+ T. d. F.).

Similar distribution. The best at Station 18.

Sub-Family NODOSARIINAE.

NODOSARIA, Lamarck.

383. *Nodosaria rotundata* (Reuss).

Glandulina rotundata, Reuss, 1849–50, FOT. p. 366, pl. xlvi (i), fig. 2.
Nodosaria (*G.*) *rotundata*, Brady, 1884, FC. p. 491, pl. lxi, figs. 17–19.

Stations 2, 3, 11, 38.

Very good specimens at Stations 2 and 38; poor at the others.

384. *Nodosaria laevigata*, d'Orbigny.

Nodosaria (*G.*) *laevigata*, d'Orbigny, 1826, TMC. p. 252, no. 1, pl. x, figs. 1–3.
,, ,, Brady, 1884, FC. pp. 490, 493, pl. lxi, figs. 17–22, 32.
,, ,, Millett, 1898, etc., FM. 1902, p. 509, pl. xi, fig. 1.

Stations 2, 6, 16, 27, 31, 54, 55.

Occurs in all the areas, rare, but large and typical. Exceptionally good at Stations 2 and 54.

385. *Nodosaria radicula* (Linné).

Nautilus radicula, Linné, 1767, etc., SN. Ed. xii, p. 1,164.
Nodosaria ,, Brady, 1884, FC. p. 495, pl. lxi, figs. 28–31.
,, ,, Millett, 1898, etc., FM. 1902, p. 513.

Stations 2, 6, 10 11.

Confined to the N.Z. area and inconspicuous, except at Station 6, where very fine examples of both the megalo- and micro-spheric forms occur.

386. *Nodosaria simplex*, Silvestri.

Nodosaria simplex, Silvestri, 1872, NFVI. p. 95, pl. xi, figs. 268–272.
,, ,, Heron-Allen and Earland, 1913, CI. p. 91, pl. viii, fig. 1.

Stations 6, 7.

Good typical specimens.

387. *Nodosaria calomorpha*, Reuss.

Nodosaria calomorpha, Reuss, 1865-6, FABS. p. 129, pl. i, figs. 15–19.
,, ,, Millett, 1898, etc., FM. 1902, p. 513.

Stations 6, 10, 17, 18, 27, 31, 36 (+ D.).

Generally distributed, but as a rule feebly developed, the number of chambers seldom exceeding three. At Station 18, however, one large and typical individual with five chambers occurs.

[Arenaceous isomorph, *Reophax membranacea*, Brady.]

388. *Nodosaria pyrula*, d'Orbigny.

Nodosaria pyrula, d'Orbigny, 1826, TMC. p. 253, no. 13.
,, ,, Brady, 1884, FC. p. 497, pl. lxii, figs. 10–12.

Stations 6, 7, 10, 11.

Recognizable fragments only, except at Station 6, where many large specimens (as usual, broken) occur. Several of these show the long-pointed primordial chamber typical of the species, and from their length must, when perfect, have attained a size of at least half an inch.

[Arenaceous isomorphs, *Reophax guttifera*, Brady, and *Hormosina ovicula*, Brady.]

389. *Nodosaria farcimen* (Soldani).

Orthoceras farcimen, Soldani, 1791, Testaceographia, vol. i, pt. 2, p. 98, pl. 105, fig. 0.
Nodosaria ,, Brady, 1884, FC. p. 498, pl. lxii, figs. 17, 18; and p. 499, figs. 13, *a–c*.
,, ,, Millett, 1898, etc., FM. 1902, p. 523.

Stations 3, 9, 11.

The only really good specimen, recent but broken, at Station 11. At Stations 3 and 9 less typical examples.

[Arenaceous isomorph, *Reophax nodulosa*, Brady.]

390. *Nodosaria soluta* (Reuss).

Dentalina soluta, Reuss, 1851, FSUB. p. 60, pl. iii, fig. 4.
Nodosaria ,, Brady, 1884, FC. p. 503, pl. lxii, figs. 13–16; pl. lxiv, fig. 28.

Stations 6, 7, 16.

Typical fragments from Stations 7 and 16, and at Station 6 a perfect specimen intermediate between this species and *L. subtertenuata*.

[Arenaceous isomorphs, *Reophax pilulifera* and *spiculifera*, Brady.]

391. *Nodosaria gracilis*, Neugeboren.

Nodosaria gracilis, Neugeboren, 1850, etc., FOL. 1852, p. 51, pl. i, figs. 27–29.

Station 6.

One large fragment, consisting of three chambers only, but measuring 4 mm., which we have no hesitation in attributing to this extremely elongated type of *N. filiformis*. As Neugeboren's name had been anticipated for a different form by d'Orbigny we might have ascribed this specimen to *N. filiformis*, d'Orb.

392. *Nodosaria filiformis*, d'Orbigny.

Nodosaria filiformis, d'Orbigny, 1826, TMC. p. 253, no. 14.
,, ,, Cushman, 1910, etc., FNP. 1913, p. 55, pl. xxvii, figs. 1–4.

Stations 6–8, 10, 16.

Confined to the N.Z. area and the deep water to the immediate south. Nothing noteworthy about the specimens except at Station 6, where recent specimens attain a remarkable size. At the same Station fossil remains occur of very much smaller dimensions. This would appear to show a change of conditions at the locality in the intervening period.

[Arenaceous isomorph, *Reophax spiculifera*, Brady.]

393. *Nodosaria communis*, d'Orbigny.

Nodosaria (*Dentalina*) *communis*, d'Orbigny, 1826, TMC. p. 254, no. 35.
,, *communis*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 670.

Stations 3–6, 8, 10, 11, 17, 18, 38 (+ R. d. J.).

Generally distributed down to Station 38. Best in the N.Z. area, where very fine and large examples occur at Stations 5 and 6. Outside this area best at Station 18. At Stations 10 and 11, where the type is small and inconspicuous, a compressed vaginuline variety occurs and is rather better developed. They closely resembled the specimens described and figured by us from the West of Scotland. H.-A. & E. 1916, FWS. p. 256, pl. xlii, figs. 1, 2.

[Arenaceous isomorph, *Reophax spiculifera*, Brady.]

394. *Nodosaria mucronata* (Neugeboren).

Dentalina mucronata, Neugeboren, 1856, OLS. p. 83, pl. iii, figs. 8–11.
Nodosaria ,, Cushman, 1910, etc., FNP. 1913, p. 56, pl. xxiv, fig. 3; pl. xxv, fig. 2; pl. xxvii, figs. 5–7; pl. xxxv, fig. 6.

Stations 6, 16, 36.

Fine and typical specimens at Station 6, smaller at the others.

395. *Nodosaria roemeri* (Neugeboren).

Dentalina roemeri, Neugeboren, 1856, OLS. p. 82, pl. ii, figs. 13–17.
Nodosaria (D.) roemeri, Cushman, 1910, etc., FNP. 1913, p. 55, pl. xxiv, figs. 4–6.

Stations 6, 10.

Very rare; best at Station 6.

396. *Nodosaria consobrina*, d'Orbigny.

Nodosaria (D.) consobrina, d'Orbigny, 1846, FFV. p. 46, pl. ii, figs. 1–3.
,, ,, Brady 1884, FC. p. 501, pl. lxii, figs. 23, 24.
,, ,, Halkyard, 1919, BMB. p. 67, pl. iv, fig. 7.

Station 6.

Large and typical.

397. *Nodosaria consobrina*, var. *emaciata*, Reuss.

Dentalina emaciata, Reuss, 1851, FSUB. p. 63, pl. iii, fig. 9.
Nodosaria consobrina, var. *emaciata*, Cushman, 1910, etc., FNP. 1913, p. 56, pl. xxvii, fig. 9.

Station 6.

Magnificent specimens.

398. *Nodosaria pauperata* (d'Orbigny).

Dentalina pauperata, d'Orbigny, 1846, FFV. p. 46, pl. i, figs. 57, 58.
Nodosaria ,, Cushman, 1910, etc. FNP. 1913, p. 51, pl. xxv, fig. 7.

Stations 1–3, 5–8, 10, 12, 16, 54.

Frequent in the N.Z. area, and also occurs in two deep-water Stations to the immediate south. Not recorded beyond this point till we reach the extreme south, at Station 54, where a single very large example was found, spinous at the base. The N.Z. specimens attain very fine dimensions at Stations 1 and 2 (recent). At the other N.Z. Stations the individuals are mostly small—both fossil and recent. At Station 2 an abnormal recent specimen in which the chambers are arranged in a zig-zag line.

[Arenaceous isomorph, *Reophax bacillaris*, Brady.]

399. *Nodosaria subtertennata*, Schwager.

Nodosaria subtertennata, Schwager, 1866, FKN. p. 235, pl. vi, fig. 74.
,, ,, Brady, 1884, FC. p. 507, pl. lxii, figs. 7, 8.

Station 6.

Good specimens, both recent and fossil.

400. *Nodosaria hispida*, d'Orbigny.

Nodosaria hispida, d'Orbigny, 1846, FFV. p. 35, pl. i, figs. 24, 25.
,, *hirsuta*, Cushman, 1910, etc., FNP. 1913, p. 60, pl. xxviii, fig. 3.

Stations 6, 7, 10, 11 (+ R. d. J.).

Confined to the N.Z. area, and all recent specimens. Frequent, and attaining very fine dimensions at Station 6, as many as five separate chambers, separated by long stolon tubes. Smaller and less developed at the other Stations.

At Station 7 the species is represented by the comparatively smooth nodosarian type without separate stolon tubes, of which Schwager's *N. setosa* may be taken as an example (S. 1866, FKN. p. 218, pl. xv, fig. 40).

[Arenaceous isomorph, *Reophax polyeides*, Deecke (1884, Abh. geol. Sp. K. Elsass Loth. vol. iv, p. 19, pl. i, fig. 2, and 1886, Mém. Soc. Émul. Montbeliard, vol. xvi, p. 14 (reprint) pl. ii, fig. 20*a*).]

401. *Nodosaria comata* (Batsch).

Nautilus (*Orthoceras*) *comatus*, Batsch, 1791, CS. p. 2, pl. i, fig. 2.
Nodosaria comata, Brady, 1884, FC. p. 509, pl. lxiv, figs. 1–5.
,, ,, Millett, 1898, etc., FM. 1902, p. 512, pl. xi, fig. 2.

Stations 3, 6.

One specimen at each Station, neither very typical.

402. *Nodosaria scalaris* (Batsch).

Nautilus (*Orthoceras*) *scalaris*, Batsch, 1791, CS. p. 2, pl. ii, fig. 4.
Nodosaria scalaris, Cushman, 1910, etc., FNP. 1913, p. 58, pl. xxiv, fig. 7.

Stations 3, 6, 10, 11 (+ R. d. J.).

Confined to the N.Z. area. There is the usual range of variation in the character of the markings, but coarsely sulcate specimens predominate, the best at Station 3. At Stations 10 and 11 the tendency is to fine striation, the markings practically disappearing in some of the latter specimens.

403. *Nodosaria raphanistrum* (Linné).

Nautilus raphanistrum, Linné, 1767, etc., SN. 1788, p. 3,372.
Nodosaria ,, Jones, Parker and Brady, 1866, etc., MFC. 1866, p. 50, pl. i, figs. 6–8.

Stations 1, 23, 27, 36.

Very rare and very small, except at Station 1, where a bilocular specimen of a large size was found.

404. *Nodosaria obliqua* (Linné).

Nautilus obliquus, Linné, 1767, SN. p. 1,163, no. 281; 1788, SN. p. 3,372, no. 14.
Nodosaria obliqua, Cushman, 1910, etc., FNP. 1913, p. 59, pl. xxv, fig. 5.

Stations 6, 16 (+ D.).

Very fine specimens at Station 6, the largest 8 mm. in length. One of

these large examples is characterized by the formation of a very thin terminal chamber less than half the size of the penultimate chamber, evidence of senility or of a moribund condition. At Station 16 a recognizable fragment only.

405. *Nodosaria vertebralis* (Batsch).

Nautilus (Orthoceras) vertebralis, Batsch, 1791, CS. p. 3, No. 6, pl. ii, figs. 6, *a*, *b*.
Nodosaria vertebralis, Cushman, 1910, etc., FNP. 1913, p. 60, pl. xxxii, fig. 1.

Station 6.

Excellent and typical examples at Station 6. Also one very large specimen ($5\frac{1}{2}$ mm.) in which the longitudinal costae, which begin strong and normal, gradually die away in later chambers, becoming smooth and sub-globular until, towards the oral extremity, the costae are mostly represented by weak bridges across the sunken sutural lines.

406. *Nodosaria catenulata*, Brady.

Nodosaria catenulata, Brady, 1884, FC. p. 515, pl. lxiii, figs. 32–34.
„ „ Cushman, 1910, etc., FNP. 1913, p. 57, pl. xxv, fig. 3.

Station 11.

Two very weak but clearly identifiable specimens.

407. *Nodosaria adolphina* (d'Orbigny).

Dentalina adolphina, d'Orbigny, 1846, FFV. p. 51, pl. ii, figs. 18–20.
Nodosaria „ Schwager, 1866, FKN. p. 235, pl. vi, figs. 72, 73.
„ *monilis*, O. Silvestri, 1872, NFVI. p. 71, pl. viii, fig. 173–189.

Stations 2, 3, 6, 7.

Limited to the N.Z. area, and all the specimens have a more or less eroded surface; probably some are of recent origin, but others are derived from beds of submarine fossil origin (See Introductory Note, p. 27). Except at Station 7, where the microspheric type occurs, the specimens being small and prominently spinous, all the specimens are megalospheric and the spinous development is scant. The best and largest are from Station 6.

D'Orbigny's species represent a well marked type, subject to great variation in the number of spines and the method of their arrangement in one or more bands round the base of the chambers. Many species have been created on the strength of these minor variations. O. Silvestri (*ut supra*) proposed to abandon d'Orbigny's specific name in favour of the name given to certain figures by Soldani, but his reasons appear to be entirely insufficient (Soldani, Testaceographia, 1789, etc., 1798, vol. ii, p. 15, pl. ii, fig. x, *Orthoceras arthrocena sive globulifera*; vol. ii, p. 35, pl. x, fig. *a*, *Orthoceras monile*; see P. & J., etc., 1859, etc., NF. 1871, p. 155, pl. ix, fig. 37). The Soldanian figures represent a smooth moniliform test, and have been identified by Brady, Parker and Jones, and others,

with d'Orbigny's *Nodosaria pyrula*, and we have no hesitation in accepting this identification.

408. *Nodosaria pellita*, sp. nov. Pl. VI, figs. 28, 29.

Station 11.

Test consisting of two chambers only, furnished with a produced neck covered with thickened bands. Basal chamber bearing in some cases a short spine. The shell-wall consists of two layers, an inner vitreous layer covered with exceedingly fine papillae, which are usually broken off, giving a granular appearance to the clear shell-substance. The outer layer consists of dense, opaque, somewhat glistening shell-substance, covering the whole of the shell and extending on to the neck. The shell, when perfect, is of a glistening white appearance owing to this external layer, which is evidently of a very fragile nature, as in many specimens it is denuded in parts, leaving the delicate hyaline inner shell unbroken.

Dimensions: —Length, ·40–·45 mm.; breadth, ·15 mm.

Confined to Station 11, where several individuals were found, in all stages of denudation.

LINGULINA, d'Orbigny.

409. *Lingulina carinata*, d'Orbigny.

Lingulina carinata, d'Orbigny, 1826, TMC. p. 257, no. 1, Modèle no. 26.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 670.

Stations 1, 2, 6.

A single exceptionally large and fine specimen at each. And at Station 6, two specimens much smaller in size and with rounded edges, comparable with *L. dentaliniformis*, Terquem (T., 1869, etc., FOM., 1870, p. 339 (p. 237 in the reprints) pl. xxv, figs. 1–3; pl. xxiii, figs. 1–7). The extent and development of the keel in this species has led to the creation of a large number of species. D'Orbigny's species is found primarily on a figure of Soldani (Testaceographia, 1798, vol. ii, p. 37, pl. xii, fig. p, etc.), which shows no trace of carination. D'Orbigny's figure (1839, FIC. pl. i, figs. 5, 6) also gives no indication of a sharp edge, but the "Modèle" (*ut supra*) has a sharp edge probably indicating a keel, and is in other respects identical with the type specimen in Paris, which we have examined. We do not attribute much, if any, importance to the carination, which, even in the most extreme examples of the species, only represents the difference between a rounded and a sharp edge, and every intermediate stage between these two may be observed in any extended series of specimens. Still less can we agree with Cushman in forming a new species, *L. grandis*, on the score of size only (C., 1917, NFP. p. 656; and 1919, RFNZ. p. 614). *L. carinata* is one of these species which vary enormously in size.

At Station 2. the large specimen shows spiral arrangement of the early portion of the shell and is referable, under extreme taxonomical stress, to *Lingulinopsis carlofortensis*, Bornemann (B., 1883, L. p. 26, pl. vi). As we have already indicated elsewhere (H., 1919, BMB. p. 81), we regard the subgenus *Lingulinopsis* as unworthy of retention, and we record this specimen merely as a biological variation from the type.

410. *Lingulina biloculi*, Wright.

Lingulina carinata, var. *biloculi*, Wright, 1910-11, ECM. p. 13, pl. ii, fig. 10.
" *biloculi*, Heron-Allen and Earland, 1913, CI. p. 94, pl. viii, figs. 5–7.

Station 55.

A single typical example from the southernmost Station. This species has only been recorded hitherto from the West of Ireland, Scotland (several "Goldseeker" dredgings), and the Estuarine Clays of Magheramorne.

FRONDICULARIA, Defrance.

411. *Frondicularia spathulata*, Brady.

Frondicularia spathulata, Brady, 1879, etc., RRC. 1879, p. 270, pl. viii, fig. 5.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 671.

Stations 2, 6, 27, 31.

Very rare, recent in the N.Z. area at Station 2, fossil at Station 6, very small but typical examples at Station 31.

412. *Frondicularia pygmaea*, Sidebottom. Pl. VI, fig. 33.

Frondicularia pygmaea, Sidebottom, 1904, etc., RFD. 1907, p. 5, pl. i, fig. 27.
" " Heron-Allen and Earland, 1913, CI. p. 96, pl. viii, fig. 14.

Station 27.

A single specimen which, to obviate the erection of a new species on such insufficient evidence, we attribute to Sidebottom's species, although it is not in strict agreement with that, or with *F. denticulo-carinata*, Chapman, another species to which it bears some features of resemblance (C., 1891, etc., GF. 1894, p. 155, pl. iii, fig. 4). The specimen is perfect, ·31 mm. long, hyaline, consisting of four chambers only, exhibiting little increase in size. The primordial chamber is carinate. The second is carinate in the lower portion and furnished with projecting recurved hooks which extend from the limbate marginal edge of the chamber. In the third and fourth chambers, although the marginal edges are limbate and projecting, they do not form hooks. The sutural lines are depressed and only slightly curved, and the specimen might be referred to either *Lingulina* or *Frondicularia*.

413. *Frondicularia inaequalis*, Costa.

Frondicularia inaequalis, Costa, 1855, FMMV. p. 372, pl. iii, fig. 3.
,, ,, Brady, 1884, FC. p. 521, pl. lxvi, figs. 8–12.
,, ,, Heron-Allen and Earland, 1908, etc., SB. 1909, p. 427; 1910, pl. vii, fig. 13.

Station 11.

A broken but recognizable specimen.

414. *Frondicularia annularis*, d'Orbigny.

Frondicularia annularis, d'Orbigny, 1846, FFV. p. 59, pl. ii, figs. 44–47.
,, ,, Bütschli, 1880, in Bronn's Klassen und Ordnungen, p. 198, pl. viii, fig. 15.

Station 6.

A single large recent specimen, presenting characters intermediate between *F. annularis*, d'Orb., and *F. reussi*, Karrer (K., 1861, FWB. p. 441, pl. i, fig. 1). The first six chambers are coarsely sulcate, the seventh faintly so, the eighth and subsequent chambers devoid of markings.

415. *Frondicularia scottii*, sp. nov. Pl. VI, figs. 30–32.

Station 2.

Test free, tongue-shaped, flattened, and with thick edges. Scored longitudinally with deep irregular grooves. Shell-wall very thick and massive, giving an opaque appearance to the shell and concealing all segmentation. When wetted the chambers are seen to be saddle-shaped, the whole of the space between the overlapping edges of the chamber-cavities being filled in with solid shell-matter through which broad tubules extend to the surface of the shell on the marginal edge. Number of chambers, up to nine.

Dimensions:—Length, ·95–1·0 mm.; breadth, ·40 mm.; thickness ·10 mm.

This is an altogether abnormal form and does not appear to be very nearly allied to any described species. The massive character of the shell-wall, enclosing and masking all segmentation, is a most distinguishing feature.

The presence of a single specimen of *F. scottii* in our collection from "Challenger" Station 185, off Raine Id., Torres Straits, 155 fms. possibly indicates a wide area of distribution for this species. The "Challenger" specimen is smaller and poorly developed, but its identity is unquestionable.

RHABDOGONIUM, Reuss.

416. *Rhabdogonium tricarinatum* (d'Orbigny).

Vaginulina tricarinata, d'Orbigny, 1826, TMC. p. 258, no. 4, Modèle no. 1.
Rhabdogonium tricarinatum, Millett, 1898, etc., FM. 1902, p. 525.

Stations 2, 6, 7.

Frequent at Stations 6 and 7; and most typical at Station 6.

MARGINULINA, d'Orbigny.

417. *Marginulina glabra*, d'Orbigny.

Marginulina glabra, d'Orbigny, 1826, TMC. p. 259, no. 6, Modèle no. 55.
" " Cushman, 1910, etc., FNP. 1913, p. 79, pl. xxiii, fig. 3.

Stations 2, 3, 6, 7, 27.

Some very fine specimens at Station 6 and a large one at Station 27. Otherwise small and poorly developed.

418. *Marginulina costata* (Batsch).

Nautilus costatus, Batsch, 1791, CS, p. 2, pl. i, fig. 1.
Marginulina costata, Millett, 1898, etc., FM. 1902, p. 526, pl. xi, fig. 20.

Stations 2, 6.

Moderately frequent. All the specimens are small, with many swollen moniliform chambers following the spiral portion, separated by deep sutures. The surface is finely sulcate. They closely resemble Cushman's new species *M. striatula* (C. 1910, etc., FNP. 1913, p. 79, pl. xxiii, fig. 4) in the formation of their chambers, but differ in the coarseness of their markings. In Cushman's species these are so fine as hardly to be indicated in his figure.

VAGINULINA, d'Orbigny.

419. *Vaginulina legumen*, (Linné).

Nautilus legumen, Linné, 1788, SN. (Ed. xiii), p. 3,373, no. 22.
Vaginulina " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 671.

Stations 3, 5 7, 10, 31.

Very fine at Stations 5 and 6, especially the latter. Large fossils at Station 6, smaller at Station 3. Small and recent at the remaining Stations.

420. *Vaginulina bruckenthali*, Neugeboren.

Vaginulina bruckenthali, Neugeboren, 1856, OLS. p. 98, pl. v, fig. 10.
" " Brady, 1884, FC. p. 532, pl. lxvi, figs. 18, 19.
" " Silvestri, 1896, etc., FPS. 1899, p. 161, pl. vii, fig. 3.

Station 2.

Fine specimens, but broad in proportion to their length, and devoid of the initial spiral.

421. *Vaginulina recta*, var. *parallela*, Halkyard.

Vaginulina recta, var. *parallela*, Halkyard, 1919, BMB. p. 82, pl. v, figs. 5, 6.

Station 6.

A single specimen, agreeing with Halkyard's variety, which, having been created, must be recognized although our views (*at supra*) remain unaltered.

CRISTELLARIA, Lamarck.

422. *Cristellaria tenuis* (Bornemann).

Marginulina tenuis, Bornemann, 1855, FSH. p. 326, pl. xiii, fig. 14.
Cristellaria ,, Brady, 1884, FC. p. 535, pl. lxvi, figs. 21–23.

Stations 3, 6.

Remarkably fine, long specimens at Station 6.

423. *Cristellaria schloenbachi*, Reuss.

Cristellaria schloenbachi, Reuss, 1862, NHG. p. 65, pl. vi, figs. 14, 15.
,, ,, Cushman, 1910, etc., FNP. 1913, p. 77, pl. xxxvi, fig. 6.

Stations 2, 6.

Rare, but typical, best at Station 6.

424. *Cristellaria tricarinella*, Reuss.

Cristellaria tricarinella, Reuss, 1862, NHG. p. 68, pl. vii, fig. 9; pl. xii, figs. 2–4.
,, ,, Brady, 1884, FC. p. 540, pl. lxviii, figs. 3, 4.

Stations 2, 6.

A small fossil specimen at Station 2. At Station 6 frequent and finely developed individuals. Some of these have one or more spines at the aboral end of the shell. The edge is thickened and rounded in all the individuals, some of them showing the rudimentary median keel from which the species derives its name. At Station 6 an abnormal specimen was found in which the young shell, after making six chambers, turned suddenly back and added another six in the same axis but directly opposite to the original line of growth.

425. *Cristellaria variabilis*, Reuss.

Cristellaria variabilis, Reuss, 1849–50, FOT. p. 369, pl. xlvi (i), figs. 15, 16.
,, ,, Cushman, 1910, etc., FNP. 1913, p. 70, pl. xxxvi, figs. 1–3.

Stations 3, 6 (+ R. d. J.).

Excellent recent specimens at both Stations. Fossil also at Station 3.

426. *Cristellaria crepidula* (Fichtel and Moll).

Nautilus crepidula, Fichtel and Moll, 1798, TM. p. 107, pl. xix, figs. *g i*.
Cristellaria ,, Cushman, 1910, etc., FNP. 1913, p. 70, pl. xxix, figs. 5, 6; pl. xxxi, figs. 2–5.

Stations 2, 3, 6, 8, 11, 36 (+ R. d. J.).

Very good specimens, often very large at Stations 2 and 6. Very small at the others, excepting at Station 3, where they are normal. Fossil specimens at Stations 2, 3 and 6.

[Arenaceous isomorph, *Haplophragmium cassis*, Parker.]

427. *Cristellaria cymboides*, d'Orbigny.

Cristellaria cymboides, d'Orbigny, 1846, FFV. p. 85, pl. iii, figs. 30, 31.
,, ,, Burrows, Sherborn and Bailey, 1890, RC. p. 560, pl. xi, fig. 6.
,, ,, Chapman, 1891, etc., GF. 1894, p. 647, pl. ix, fig. 6.

Stations 6, 7.

Good specimens.

428. *Cristellaria acutauricularis* (Fichtel and Moll).

Nautilus acutauricularis, Fichtel and Moll, 1798, p. 102, pl. xviii, figs *g–i*.
Cristellaria ,, Cushman, 1910, etc., FNP. 1913, p. 69, pl. xxxv, fig. 2.

Stations 2, 6, 7, 36.

Frequent and very typical at Station 6. Less typical at the other N.Z. Stations. Very small, but typical at Station 36.

429. *Cristellaria paucisepta*, Reuss.

Cristellaria paucisepta, Reuss, 1852, SFL. p. 17, figs. *a*, *b*.

Station 18.

A single specimen which appears to represent Reuss's figure. The species named *C. paucisepta* by Seguenza (S. 1879–80, FTR. p. 141, pl. x [error for xiii], fig. 13) is an entirely different form, allied to *C. crassa*. Reuss's paper is probably unknown to most workers in the group.

430. *Cristellaria latifrons*, Brady.

Cristellaria latifrons, Brady, 1884, FC. p. 544, pl. lxviii, fig. 19; pl. cxiii, figs. 11, *a*, *b*.
,, ,, Chapman, 1891, etc., GF. 1894, p. 652, pl. x, figs. 8, *a*, *b*.

Station 6.

Frequent and splendidly developed. Some of the specimens attain a great length, the spiral portion representing a quite inconspicuous part of the shell, which becomes rapidly evolute.

431. *Cristellaria italica* (Defrance).

Saracenaria italica, Defrance, Dict. Sci. Nat., 1824, vol. xxxii, p. 177; 1827, vol. xlvii, p. 344.
Cristellaria ,, Cushman, 1910, etc., FNP. 1913, p. 78, pl. xxxiii, fig. 3.

Station 6.

Confined to this Station, where it frequently attains a very large size.

432. *Cristellaria convergens*, Bornemann.

Cristellaria convergens, Bornemann, 1855, FSH. p. 327, pl. xiii, figs. 16, 17.
,, ,, Heron-Allen and Earland, 1916, FWS. p. 262, pl. xlii, figs. 11–14.

Stations 2, 3, 8, 16, 36.

Rare, fossil at Station 3, and the best, though small, at Station 36.

433. *Cristellaria gibba*, d'Orbigny.

Cristellaria gibba, d'Orbigny, 1839, FC. p. 40, pl. vii, figs. 20, 21.
,, ,, Cushman, 1910, etc., FNP. 1913, p. 69, pl. xxxv, fig. 1.

Stations 1–3, 6–8, 16, 19, 20.

Excepting at Station 6, where it is frequent and typical and large, the specimens are not noteworthy.

434. *Cristellaria articulata* (Reuss).

Robulina articulata, Reuss, 1863–4, KTF. p. 53, pl. v, fig. 62; pl. vi, fig. 63.
Cristellaria ,, Cushman, 1910, etc., FNP. 1913, p. 65, pl. xxxi, fig. 1.

Stations 1, 2, 3, 6, 27.

Confined to the N.Z. area, except for one compressed individual at Station 27. In the N.Z. area it is very large and typical, and also fossil and typical at Station 6. At Stations 1 and 3 not conspicuous. Station 2 is marked by a profusion of wild-growing specimens in every stage of development, from a single fistulose chamber on a normal shell, to larger and more complex and protean examples than those figured by Brady. Incidentally these confirm Brady's judgment in attributing his specimens to *Cristellaria* and disprove Schlumberger's contention that these wild growths are an *Amphicoryne* related to his *A. parasitica* (S., 1892, FAM. p. 197, pl. viii, figs. 10–12). Whatever Schlumberger's form may be (and we suspect that it is identical with Brady's) there is no doubt that Brady's specimens and our own are developments of *C. articulata*.

435. *Cristellaria rotulata* (Lamarck).

Lenticulites rotulata, Lamarck, 1804, AM. p. 188, no. 3; 1816, TEM. pl. 466, fig. 5.
Cristellaria ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 671.

Stations 1–7, 10–12, 18, 36.

Generally distributed down to Station 18, and a broken specimen at Station 36. It often attains considerable size at the N.Z. Stations, especially at Stations 2 and 6. Fossils at Stations 2, 3 and 6.

436. *Cristellaria vortex* (Fichtel and Moll).

Nautilus vortex, Fichtel and Moll, 1798, TM. p. 33, pl. ii, figs. *d–i*.
Cristellaria ,, Cushman, 1910, etc., FNP. 1913, p. 68, pl. xxxii, fig. 3.

Stations 1, 2, 3, 6.

Confined to the N.Z. area. Very fine and typical at Station 6.

437. *Cristellaria orbicularis* (d'Orbigny).

Robulina orbicularis, d'Orbigny, 1826, TMC. p. 288, no. 2, pl. xv, figs. 8, 9.
Cristellaria ,, Cushman, 1910, etc., FNP. 1913, p. 67, pl. xxxvi, figs. 4, 5.

Stations 1, 2, 6.

Confined to the N.Z. area and rare, except at Station 6, where the specimens are very good.

438. *Cristellaria cultrata* (Montfort).

Robulus cultratus, Montfort, 1808-10, CS. vol. i, p. 214, 54e genre.
Cristellaria cultrata, Heron-Allen and Earland, 1914, etc., FKA, 1915, p. 672.

Stations 1 3. 6. 10. 11. 16. 22. 31 (+ R. d. J.).

Extremely fine and large, and often with splendid development of the keel at Station 6; good also at Station 11, and one enormous broken specimen at Station 16. Otherwise not very frequent or typical.

439. *Cristellaria calcar* (Linné).

Nautilus calcar, Linné, 1767, etc., SN. 1788, p. 3.370, no. 2.
Cristellaria calcar, Cushman, 1910, etc., FNP. 1913, p. 72, pl. xxxii, fig. 4.

Stations 11, 12.

Small specimens only, with the spines weakly developed.

440. *Cristellaria costata* (Fichtel and Moll). Pl. VI, fig. 34.

Nautilus costatus, Fichtel and Moll, 1798, TM. p. 47, pl. iv, figs. *g–i*.
Cristellaria costata, Cushman, 1910, etc., FNP. 1913, p. 75, pl. xxxiv, fig. 4.

Stations 2, 6.

Occurs as recent and finely developed specimens, especially at Station 6. At Station 2, in addition to the type, a thin compressed evolute variety, which we figure, occurs, with sunken sutures, and the limbation running parallel with the outer margin of the test. (Length, 1·50 mm.) This appears to be intermediate between *C. paucicostata*, Cushman, and *C. dorsocostata*, Cushman, but does not exactly conform to any of the many variations of *C. costata* figured by him in his latest monograph on "Foraminifera of the Philippine and Adjacent Seas" (1921, U.S. National Museum, Bulletin 100).

Sub-Family POLYMORPHININAE.

POLYMORPHINA, d'Orbigny.

441. *Polymorphina lactea* (Walker and Jacob).

Serpula lactea, Walker and Jacob, 1798, AEM. p. 634, pl. xiv, fig. 4.
Polymorphina lactea, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 672.

Stations 2, 3, 5.

The best at Stations 2 and 5. Fossils at Stations 2 and 3.

442. *Polymorphina oblonga*, Williamson. Pl. VII, fig. 2.

Polymorphina lactea, var. *oblonga*, Williamson, 1858, RFGB. p. 71, pl. vi, fig. 149.
„ *oblonga*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 672.

Stations 2, 3, 5, 6.

Very fine fossil specimens, but none recent. At Station 5 a specimen, ·70 mm. long, covered entirely with short, stout spines. This, from its appearance, may be either a very well preserved fossil, or a recent specimen. In view of the distinctly fossil character of the other specimens we incline to the former conclusion.

443. *Polymorphina gibba*, d'Orbigny.

Polymorphina (*Globulina*) *gibba*, d'Orbigny, 1826, TMC. p. 266, no. 20, Modèle no. 63.
„ *gibba*, Cushman, 1910, etc., FNP. 1913, p. 85, pl. xli, fig. 4.

Stations 2, 3, 5, 6, 16, 53.

The best specimens in the N.Z. area at Station 5. At the other N.Z. Stations fistulose examples are almost as common as the normal. Fossils at Stations 2, 3 and 6, both normal and fistulose. Outside this area the records depend on single specimens at Stations 16 and 53.

444. *Polymorphina sororia*, Reuss. Pl. VII, fig. 1.

Polymorphina (*Guttulina*) *sororia*, Reuss, 1863, FCA. p. 151, pl. ii, figs. 25–29.
„ *sororia*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 673.

Stations 2, 6, 9, 10, 18, 22, 26, 27, 55.

As a rule the specimens are small, but good at Station 22, and in the N.Z. area, at Stations 2 and 6, both recent and fossil. An interesting recent specimen ·60 mm. long, at Station 6, fistulose and hispid all over.

445. *Polymorphina angusta*, Egger.

Polymorphina angusta, Egger, 1857, MSO. p. 290, pl. xiii, figs. 13–15.
„ „ Brady, 1884, FC. p. 563, pl. lxxii, figs. 1–3.

Station 6, 9, 11, 16, 18, 22 (+ T. d. F.).

Very rare, the best at Stations 16 and 18.

446. *Polymorphina lanceolata*, Reuss.

Polymorphina lanceolata, Reuss, 1851, FSUB. p. 83, pl. vi, fig. 50.
„ „ Cushman, 1910, etc., FNP. 1913, p. 86, pl. xl fig. 2.

Stations 17, 18.

A good and typical specimen at each Station.

447. *Polymorphina ovata*, d'Orbigny.

Polymorphina ovata, d'Orbigny, 1846, FFV. p. 233, pl. xiii, figs 1–3.
„ „ Cushman, 1910, FNP. 1913, p. 87, pl. xxx, fig 2

Station 2, 18.

One fossil specimen at Station 2, and a small recent example at Station 18.

448. *Polymorphina compressa*, d'Orbigny.

Polymorphina compressa, d'Orbigny, 1846, FFV. p. 233, pl. xii, figs. 32–34.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 672.

Stations 2, 3, 6, 27.

Fine specimens in the N.Z. area, especially at Station 6. Fistulose at Station 2. Fossils at all the N.Z. Stations. At Station 6 a large abnormal individual intermediate between *P. compressa* and *P. ovata* in the arrangement of the chambers. Outside the N.Z. area the record depends on a single specimen at Station 27. Pearcey's *P. inflata* appears to be merely a pauperate form of this species. P. 1914, SNA. p. 1023, pl. ii, figs. 14–16.

449. *Polymorphina elegantissima*, Parker and Jones.

Polymorphina elegantissima, Parker and Jones, 1865, NAAF. p. 438.
" " Cushman, 1910, etc., FNP. 1913, p. 90, pl. xxxviii, fig. 1.

Stations 1, 2, 3, 5, 6.

This handsome species is the most typical N.Z. representative of the genus. Specimens are abundant and attain large size, especially at Stations 2 and 6. Fossils at Stations 1, 2, 3 and 6. The species does not appear to be subject to fistulose variation.

450. *Polymorphina problema*, d'Orbigny.

Polymorphina problema, d'Orbigny, 1826, TMC. (*Guttulina*), p. 266, no. 14; Modèle (*Polymorphina*) no. 61.
" " Brady, 1884, FC. p. 568, pl. lxxii, fig. 20; pl. lxxiii, fig. 1.
" " Millett, 1898, etc., FM, 1902, p. 264.

Stations 6, 45, 55.

A good series, extending from *P. communis* to the most elongate type of d'Orbigny's *P. oblonga* at Station 6, all recent. A single specimen at Station 45, and two fairly large specimens at Station 55, farthest S.

451. *Polymorphina communis*, d'Orbigny.

Polymorphina (*Guttulina*) *communis* and *problema*, d'Orbigny, 1826, TMC. p. 266, nos. 14 and 15, pl. xii, figs. 1–4; Modèles nos. 61, 62.
" *communis*, Heron-Allen and Earland, 1914, etc., FKA, 1915, p. 673.

Stations 1–3, 5, 6, 48.

Confined to the N.Z. area except for one very small specimen at Station 48. Common at Station 6, where fistulose examples occurred. The largest, perhaps, at Station 1. Fossils at Stations 2, 3 and 6.

452. *Polymorphina rotundata* (Bornemann).

Guttulina rotundata, Bornemann, 1855, FSH. p. 346, pl. xviii, fig. 3.
Polymorphina rotundata, Cushman, 1910, etc., FNP. 1913, p. 88, pl. xl, fig. 1.

Stations 3, 6, 36.

Very rare, and the specimens are not typical.

453. *Polymorphina longicollis*, Brady.

Polymorphina lanceolata, Reuss, 1870, FSP. p. 487 (S. 1870, FSP. pl. xxxi, figs. 25–28).
,, *longicollis*, Cushman, 1910, etc. FNP. 1913, p. 90, pl. xli, figs. 1–3.

Station 16.

Two large individuals, less pointed at the aboral end than Brady's type suggests, and one pointed specimen hispid all over.

UVIGERINA, d'Orbigny.

454. *Uvigerina canariensis*, d'Orbigny.

Uvigerina canariensis, d'Orbigny, 1839, FIC. p. 138, pl. i, figs. 25–27.
,, ,, Cushman, 1910, etc., FNP. 1913, p. 92, pl. xlii, fig. 6.

Stations 2, 6, 18, 31 (+ K. I.).

A single good specimen at Station 31. Intermediate forms at the other Stations.

455. *Uvigerina pygmaea*, d'Orbigny.

Uvigerina pygmaea, d'Orbigny, 1826, TMC. p. 269, pl. xii, figs. 8, 9: Modèle no. 67.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 675.

Stations 3, 4, 6–12, 14, 16, 32, 49, 55 (+ K. I., R. d. J., D.).

Generally distributed, especially good in the N.Z. area, particularly at Stations 10–12, where it attains a great size and is very variable, passing imperceptibly into *U. angulosa* and *aculeata*. At Stations 11 and 12 both long and short forms occur, and at Station 12 the long forms are spinous on the primordial chambers. In the deep water, good specimens at Station 16, short type only at Station 32. It passes into *U. angulosa* at Station 49. At Station 55, farthest South, the specimens are small.

456. *Uvigerina angulosa*, Williamson.

Uvigerina angulosa, Williamson, 1858, RFGB. p. 67, pl. v, fig. 140.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 676.

Stations 1–3, 5–9, 11, 12, 14, 16, 18, 22, 26, 27, 29–32, 38, 41, 45–50, 53–55 (+ R. d. J., D.).

Common and almost universally distributed. As might be expected with such an enormous range of latitude and depth, the specimens include variations of every nature. The finest in the N.Z. area are at Stations 2 and 6. In the deep-water area the species is less abundant and less variable, but with shallow gatherings (Stations 26 and 27) it resumes its predominance and its wild tendency to variation, both in length and nature of markings; finely striate and sulcate,

hispid at Station 27, where specimens passing imperceptibly into *U. aculeata* and *U. pygmaea* occur, as also at Stations 38, 45, 53, and 54. At the southernmost Stations it is one of the most common and best developed Foraminifera. Fossil specimens at Stations 2, 3 and 6.

457. *Uvigerina brunnensis*, Karrer.

Uvigerina brunnensis, Karrer, 1877, HW. p. 385, pl. xvi, (*b*), fig. 49.
„ „ Cushman, 1910, etc., FNP. 1913, p. 97, pl. xliii, fig. 2.

Station 11.

A few fairly distinctive specimens.

458. *Uvigerina aculeata*, d'Orbigny.

Uvigerina aculeata, d'Orbigny, 1846, FFV. p. 191, pl. xi, figs. 27, 28.
„ „ Cushman, 1910, etc., FNP. 1913, p. 100, pl. xliii, fig. 4.

Stations 6, 10, 11, 16, 18, 22 (+ D.).

This species has its headquarters at Station 6, where it reaches an enormous size and very fine development of the spines, which often extend all over the shell. At the other Stations the specimens are less abundant and less strongly developed, but very good at Station 18. There is the usual tendency to run imperceptibly into *U. pygmaea*, *angulosa*, and *asperula*.

459. *Uvigerina asperula*, Czjzek.

Uvigerina asperula, Czjzek, 1848, FWB. p. 146, pl. xiii, figs. 14, 15.
„ „ Cushman, 1910, etc., FNP. 1913, p. 101, pl. xliii, fig. 1.

Stations 6-8, 10–12, 14, 22, 23, 27, 31, 36 (+ D.).

Occurs in the N.Z. area and northerly Antarctic. In the N.Z. area best at Stations 6, 7 and 10 and passes into var. *ampullacea*. In the deep water the best Station is 22, where very fine specimens occur. At Station 23 the surface is covered with very long delicate spines (setose); at Station 27 it is hardly separable from *U. angulosa*, which at this Station becomes spinous.

460. *Uvigerina asperula*, var. *ampullacea*, Brady.

Uvigerina asperula, var. *ampullacea*, Brady, 1884, FC. p. 579, pl. lxxv, figs. 10, 11.
„ „ „ „ Cushman, 1910, etc., FNP. 1913, p. 102, pl. xlii, fig. 3.

Stations 6, 7, 10 (+ R. d. J.).

Good examples at each Station.

461. *Uvigerina auberiana*, d'Orbigny.

Uvigerina auberiana, d'Orbigny, 1839, FC. p. 106, pl. ii, figs. 23, 24.
„ „ Cushman, 1910, etc., FNP. 1913, p. 102, pl. xxxvii, fig. 5.

Station 7.

A single specimen.

462. *Uvigerina auberiana*, var. *glabra*, Millett.

Uvigerina auberiana, d'Orbigny, 1839, FC. p. 106, pl. ii, figs. 23, 24.
,, ,, var. *glabra*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 674.

Station 6.

A few typical specimens.

463. *Uvigerina interrupta*, Brady.

Uvigerina interrupta, Brady, 1879, etc., RRC. 1879, p. 274, pl. viii, figs. 17, 18; 1884, FC. p. 580, pl. lxxv, figs. 12–14.
,, ,, Cushman, 1910, etc., FNP. 1913, p. 103, pl. xliv, fig. 1.

Station 6.

Very fine and elongate, delicately spinous specimens.

SAGRINA, d'Orbigny, emend. Parker and Jones.

The genus *Sagrina* makes its first appearance in d'Orbigny's monograph on the Cuban Foraminifera (1839), and was named by him after de la Sagra, of whose work on the Island it formed an integral part. Bronn in 1851, Reuss in 1865 (models), Marsson in 1878 and others subsequently, have adopted the name *Sagraina*, which is obviously more correct in the circumstances. We prefer, however, to adhere to the original spelling.

The name *Siphogenerina* was coined by Schlumberger in 1883 to include all those Foraminifera in which the aperture extended in the form of a siphon, or tube, through the successive chambers of growth. This method of classification, though perhaps taxonomically convenient, is false zoologically, because species, widely separated generically, present this feature in common, whereas individuals of the same genus in some species possess a siphon and in others lack it. Even within the limits of a species the presence or absence of a siphon may be observed, as in *Sagrina raphanus*, which has sometimes an external neck and no siphon, and in others has no neck, but has the internal tube. Considerable confusion has thus been introduced into synonymies, and we think that Schlumberger's generic name should be abandoned and the species be redistributed among the genera to which they undoubtedly belong.

464. *Sagrina columellaris*, Brady.

Sagrina columellaris, Brady, 1879, etc., RRC. 1881, p. 64; 1884, FC. p. 581, vol. lxxv, figs. 15–17.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 676.

Stations 5, 6.

Very rare, recent specimens.

465. *Sagrina bifrons*, Brady.

Sagrina bifrons, Brady, 1879, etc., RRC. 1881, p. 64; 1884, FC. p. 582, pl. lxxv, figs. 18–20.
Siphogenerina bifrons, Cushman, 1910, etc., FNP, 1913, p. 105, pl. xlv, figs. 1, 2, 5–7.

Stations 2, 3, 6.

All the specimens are fossils, and exhibit every possible variation of multiformity. Sometimes the biserial or triserial chambers occupy a large portion of the test, in others they are merely indicated at the aboral end. Many of the specimens are feebly striate, passing into *S. striata*.

466. *Sagrina dimorpha*, Parker and Jones.

Uvigerina (*Sagrina*) *dimorpha*, Parker and Jones, 1865, NAAF. p. 364, pl. xviii, fig. 18.
Sagrina dimorpha, Heron-Allen and Earland, 1916, FWS. p. 266, pl. xlii, figs. 17, 18.

Stations 3, 6, 7, 10, 11.

Confined to the N.Z. area; very rare, but quite typical.

467. *Sagrina virgula*, Brady.

Sagrina virgula, Brady, 1879, etc., RRC. 1879, p. 275, pl. viii, figs. 19–21.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 676, pl. li, figs. 4, 5.

Station 16.

A single specimen of the deep-water type with large cup-shaped orifice.

468. *Sagrina striata* (Schwager).

Dimorphina striata, Schwager, 1866, FKN. p. 251, pl. vii, fig. 99 and text-fig. 2.
Sagrina " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 676, pl. li, figs. 6–8.

Stations 2 and 3.

Rare, all fossils.

469. *Sagrina raphanus*, Parker and Jones.

Uvigerina (*Sagrina*) *raphanus*, Parker and Jones, 1865, NAAF. p. 364, pl. xviii, figs. 16–17.
Sagrina raphanus, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 677.

Stations 1, 2.

At Station 1 strongly marked, thick-shelled, entosolenian, and recent. At Station 2 a single small, and rather uncertain, fossil example with a produced neck.

Sub-Family RAMULININAE.

RAMULINA, Rupert Jones.

470. *Ramulina globulifera*, Brady.

Ramulina globulifera, Brady, 1879, etc., RRC. 1879, p. 272, pl. viii, figs. 32, 33; 1884, FC. p. 587, pl. lxxvi, figs. 22–28.
" " Cushman, 1910, etc., FNP. 1913, p. 110, pl. xxxix, fig. 1.

Stations 3, 6, 11.

Fragments of tubes at Stations 3 and 11; at Station 6 a good series of specimens, often of considerable size, showing the branching arms diverging from the globular chambers.

471. *Ramulina* (?), Text-figure.

Station 2.

A single example of a very large abnormal organism, the precise nature of which can only be a matter of speculation. It can best be compared with the fistulose outgrowths of the *racemosa* type figured by Jones and Chapman (J. & C. 1896–8, FPR. p. 504, figs. 17 19), but it differs from anything of this nature that can be imagined in its enormous size. It is difficult to imagine any single individual *Polymorphina* extruding sufficient protoplasm to form such a mass of labyrinthic tubes. Many of the extensions are broken, but here and there nipple-like apertures may be traced on the projecting tubes. Perhaps the nearest organism hitherto figured with which it may be compared is the *R. grimaldii*, Schlumberger (Note sur le *R. grimaldii*, Mém. Soc. Zool., France, vol. iv, 1891, pp. 509–511 (151–153 in reprint), pl. v), but this abnormal form differs considerably and is of a less complicated structure. Our organism measures 5 by 3 mm. and has a depth of 2 mm.

Family GLOBIGERINIDAE.

GLOBIGERINA, d'Orbigny.

472. *Globigerina bulloides*, d'Orbigny.

Globigerina bulloides, d'Orbigny, 1826, TMC. p. 277, no. 1; Modèles nos. 17 and 76.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 678.

Stations 1–12, 14, 16, 19, 23, 26–29, 31, 32, 38, 41, 48, 50, 53 (+ T. d. F., K. I., D.).

Universally distributed, and in the N.Z. area splendidly developed and characteristic, especially at Stations 2, 3 and 6, where a large number of specimens were of pelagic origin. At Stations 10, 11, 12 large benthic individuals. There is a considerable range of variation in the direction of *G. dubia* at Station 6, and of *G. dutertrei* at Stations 5, 6 and 7, also at Station 16, and from Station 27. To the south the typical *G. bulloides* gradually dies out and the specimens found might equally be referred to *G. dutertrei*.

[Arenaceous isomorph, *Haplophragmium globigeriniforme* (P. & J.).]

473. *Globigerina triloba*, Reuss.

Globigerina triloba, Reuss, 1849–50, FOT. p. 374, pl. ii (xlvii), fig. 11.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 678.

Stations 1–3, 5–7, 9, 11 (+ K. I., R. d. J.).

Confined to the N.Z. area, the best at Stations 2 and 6. The size of the

hexagonal pits surrounding the tubuli is noticeably larger in this species than in *G. bulloides*.

474. *Globigerina dubia*, Egger.

Globigerina dubia, Egger, 1857, MSO. p. 281, pl. v (ix), figs. 7–9.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 678.

Stations 2, 3, 6, 7, 8, 11, 12, 27 (+ T. d. F., R. d. J., D.).

Very large and characteristic specimens at Stations 2, 3 and 6. Outside these Stations the specimens are few in number and smaller and much less characteristic.

[Arenaceous isomorph, *Haplophragmium globigeriniforme*, (P. & J.) (*pars*) = *Trochammina subturbinata*, Cush. (C., 1920, FAO. p. 81, pl. xvi, figs. 7, 8).]

475. *Globigerina cretacea*, d'Orbigny.

Globigerina cretacea, d'Orbigny, 1840, CBP. p. 34, pl. iii, figs. 12–14.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 678, pl. li, figs. 10–13.

Stations 18, 20, 26 (+ T. d. F.).

Very rare. The best examples at Station 18.

476. *Globigerina cretacea*, var. *eggeri*, nov. Pl. VII, figs. 6–8.

Globigerina aequilateralis, Egger, 1899, KOA. p. 169, pl. xxi, figs. 11, 21–23; 1910, FKR, p. 36, pl. iv, figs. 17–19.

Station 6.

A single delicate specimen, ·22 mm. in diameter, exhibiting seven chambers on the inferior side, and two complete whorls of chambers on the upper or rotaline surface. It is clearly allied to the *G. cretacea* group, but does not agree with either the type or the species *sub-cretacea* instituted by Chapman for the recent forms of *G. cretacea* figured by Brady (C., 1901, FFA. p. 410, pl. xxxvi, fig. 16). On the other hand the N.Z. specimen does very closely resemble a little form which has been figured by several authors under the name *G. aequilateralis*, Brady, disregarding the fact that *G. aequilateralis* should, as its name suggests, be aequilateral, presenting a similar appearance on both faces. We have associated our variety with the name of Egger, who is responsible for the original misapplication of the name *G. aequilateralis*.

These small, compressed rotaline Globigerinae are very rare, but we have observed them before in several tropical and sub-tropical gatherings.

477. *Globigerina inflata*, d'Orbigny.

Globigerina inflata, d'Orbigny, 1839, FIC. p. 134, pl. ii, figs. 7–9.
" " Heron-Allen and Earland, 1914, etc. FKA. 1915, p. 679.

Stations 1–12, 31, 32, 52 (+ T. d. F., D.).

Universal in the N.Z. area, often abundant, and remarkably well developed,

especially at Stations 2, 3 and 6. Fossils at Stations 2 and 3. Outside the N.Z. area the records are few and the specimens poor.

[Arenaceous isomorph, *Haplophragmium globigeriniforme* (P. & J.) (*pars*) = *Trochammina globulosa*, Cush. (C., 1920, FAO. p. 77, pl. xvi, figs. 3, 4).]

478. *Globigerina dutertrei*, d'Orbigny.

Globigerina dutertrei, d'Orbigny, 1839, FC. p. 84, pl. iv, figs. 19–21.
,, ,, Brady, 1884, FC. p. 601, pl. lxxxi, figs. 1, *a–c*.
,, *bulloides*, Murray and Renard, 1891, Chall. Rep. Deep Sea Deposits, pp. 163, 165, 214, 261, pl. xv, fig. 1 (3).
,, *dutertrei*, Chapman, 1909, SNZ. p. 350; 1914, FORS. p. 69, pl. v, fig. 36.
,, ,, Pearcey, 1914, SNA. p. 1,024.
,, *bulloides*, Fauré Fremiet, 1913, etc., FMAF. 1913, p. 264; 1914, p. 6, pl. 0, fig. 10.
,, *dutertrei*, Sidebottom, 1918, FECA. p. 150, pl. v, figs. 25–27.

Stations 1–3, 5, 6, 8–11, 13–20, 22–24, 26–38, 41, 42, 45–48, 50, 53–55 (+ T. d. F., K. I., R. d. J., D.).

NOTE.—In 1839 d'Orbigny figured this species as a somewhat high, inflated, rotaliform type, having a single small-looped aperture visible only on the underside, and confined to the last chamber. His specimen was evidently drawn from a thin-walled surface-, or shallow-water, specimen. It represents a very distinctive type, differing considerably from *G. bulloides* (which it closely resembles as seen from the superior side), in having this single aperture to the final chamber, instead of each chamber opening, as in *G. bulloides*, into the umbilical recess. After the Cuba monograph the species seems to have been entirely ignored, and although it occurs commonly in company with *G. bulloides*, and much work was done with the *Globigerina* oozes, it was not separated again until Brady dealt with the "Challenger" Collections, when he re-figured the species, using a thick-walled benthic specimen as his type, his figure thus differing slightly from d'Orbigny's. But he fully recognized the distinctness and importance of the type, though curiously enough it is not represented in his table of Globigerinae found in the various types of deep-sea deposits, including *Globigerina* ooze, although it does figure in his table of characteristic Foraminifera from high latitudes north and south. Even there it figures from one Station only in the Antarctic, and from none of the Arctic gatherings. It is probable that these records of material were not worked out by Brady himself, but by assistants, who failed to distinguish the type, with the result that Brady in his Report (p. 601), commits himself to a statement that "*G. dutertrei* takes the place of the typical *G. bulloides* in the Antarctic Seas, just as *G. pachyderma* represents the type in Arctic latitudes."

This is not the case; our own examination of material from the northern North Sea had long ago proved to us that *G. dutertrei* gradually replaces *G. bulloides* as we go north, and now our work on the "Terra Nova" material proves

that it extends equally far to the south, and that in the most southerly latitudes it is more or less replaced by *G. pachyderma*, as in the Arctic Seas.

Dr. Harvey Pirie, in his Memoir on "The Deep Sea Deposits of the Scottish National Antarctic Expedition" (P., 1913, SNA.), records the presence of the two forms together in many of the deposits examined by him.

G. dutertrei becomes the dominant type at Station 16, where the Foraminifera in the material consisted of 95 per cent. of this species; and at Stations 17, 18 and 20 at least 99 per cent. of the whole material as dredged. South of these Stations the nature of the material becomes normally varied, with a corresponding decrease in the number of the Globigerinae.

Universally distributed, but in the N.Z. area rare, except at Station 9, where many very good examples were found. In the deep water those soundings, which were *Globigerina* oozes, consisted almost entirely of this species, as recorded above. In the Antarctic coastal area the Globigerinae naturally form a smaller percentage, but *G. dutertrei* retains its dominant position among the Globigerinae, becoming more thick-shelled, starved and approximating by imperceptible degrees to *G. pachyderma*, until at many Stations it is difficult to draw a line by which the specimens of the species can be separated from the other. Well-marked individuals of *G. dutertrei*, however, occur everywhere and particularly at Stations 36, 38 and 53. At the dominant Stations large numbers of abnormal and wild-growing specimens occur, ranging between double individuals inseparable from *G. helicina*, to "sports" in which individual chambers are malformed and tubular, in fact the species seems more subject to these biological malformations than any other Globigerinae. Many of the benthic specimens also exhibit excessive thickening of the shell-wall by the deposition of concentric layers of calcium carbonate. Such thickening, by obliterating the sutural depressions, brings the smaller specimens into practical identity with *G. pachyderma* when the oral aperture is of a depressed character.

Kiaer (K., 1899, NNAE. pl. i. fig. 7) figures similar specimens with tubular outgrowths as "*Globigerina* sp." from the Arctic Seas.

[Arenaceous isomorph. *Haplophragmium globigeriniforme*, P. & J.]

479. *Globigerina pachyderma* (Ehrenberg).

Aristerospira pachyderma, Ehrenberg, 1873, LMT. p. 386, pl. i, fig. 4.
.. *crassa*, Ehrenberg, *ibid*, p. 388, pl. iii, fig. 9.
Globigerina omphalotetras, Ehrenberg, *ibid*, p. 388, pl. iii, fig. 11.
.. *bulloides*, Brady, 1878, RRNP ("Arctic variety") p. 435, pl. xxi, fig. 10.
.. .. var. *borealis*, Brady, 1882, FKE. p. 716, 717.
.. *pachyderma*, Brady, 1884, p. 600, pl. cxiv, figs. 19, 20.
.. .. Murray and Renard, 1891, Chall. Rep. "Deep Sea Deposits," p. 260. pl. xxv, fig. 12.
.. .. Heron-Allen and Earland, 1908, etc., SB 1909, p. 438, pl. xviii, figs. 4, 5.
.. . Pearcey, 1914, SNA. p. 1,024 (*c*).

Stations 2, 3, 5, 11, 13, 15, 18, 20, 26–31, 33, 35–38, 42, 45–48, 50, 52–55 (+ K. I., D.).

Note.—The early Bibliography of this species has been fully dealt with by Brady (*ut supra*). He appears to have been convinced that it was a purely Arctic form, and failed to record it in the Antarctic gatherings of the "Challenger." Pearcey, dealing with the "Scotia" material, and having practical knowledge of northern gatherings in which *G. pachyderma* occurs, recognized the form in the south, and recorded it from the Antarctic. It does not occur in Chapman's Antarctic records. We are still uncertain as to the specific value of the species. The evidence, in our opinion, rather tends in the direction that it is a varietal form due to the suppression of the comparatively large single aperture of the typical *G. dutertrei*, combined with a reduction of the general dimensions, and particularly with a massive thickening of the shell-wall. In any large assemblage of specimens of *G. dutertrei* it is not difficult to find a series in which the aperture ranges from a high arch to a narrow slit, and when this last form assumes a thick shell-wall obliterating the sutural lines, we reach a specimen which is practically indistinguishable from typical *G. pachyderma*.

In the N.Z. area the specimens are few in number. At Stations 2 and 3 their nature is more or less uncertain; they may possibly be excessively thick-walled and starved individuals of *G. inflata*. At Stations 5 and 11, however, the few individuals are typical. South of N.Z. the form increases in frequency; very good specimens occur at Station 28, and as one approaches the South Pole the proportion of typical specimens as compared with thick-walled transition-stages of *G. dutertrei* increases. The only Station at which *G. pachyderma* is recorded and not *G. dutertrei*, is Station 52.

480. *Globigerina rubra*, d'Orbigny.

Globigerina rubra, d'Orbigny, 1839, FC. p. 82, pl. iv, figs. 12, 14.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 679.

Stations 1–3, 6, 7, 54 (+ R. d. J.).

Never common, but good typical specimens at Stations 2, 3, and 6, and a single good one at Station 54. Only two specimens were found showing the characteristic red colour (Stations 2 and 6).

481. *Globigerina rubra*, var. *elevata*, d'Orbigny.

Globigerina elevata, d'Orbigny, 1840, CBP. p. 34, pl. iii, figs. 15, 16.
" *trochoides*, Reuss, 1845–6, VBK. (1), p. 36, pl. xii, fig. 22.
" sp. (?) *rubra*, Brady, 1884, FC. p. 603, pl. lxxxii, figs. 8, 9.
" *rubra* (?), Chaster, 1892, FS, p. 64.
" " Heron-Allen and Earland, 1913, CI. p. 105; 1913, FNS. p. 131, pl. x, figs. 13, 15.

Stations 8–11, 14, 31, 36.

Abundant and very finely developed at Station 10. The occurrence of this little form as a predominant type in an area so far removed from the British coasts, where it has been consistently recorded as *G. rubra*, renders it necessary to revive the d'Orbignyan name. It is probably one of the universally distributed Foraminifera, but, by reason of its minute size, it escapes observation or is regarded as an immature test.

482. *Globigerina conglobata*, Brady.

Globigerina conglobata, Brady, 1879, etc., RRC. 1879, p. 286; 1884, FC. p. 603, pl. lxxx, figs. 1–5.
.. .. Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 680.

Stations 2, 6, 7, 12, 48.

Large and very typical at Stations 2 and 6, less typical at the others. Small fossil specimens at Station 2.

483. *Globigerina sacculifera*, Brady.

Globigerina sacculifera, Brady, 1877, FNB. p. 535; 1884, FC. p. 604, pl. lxxx, figs. 11–17.
.. .. Millett, 1898, etc., FM. 1903, p. 688.

Stations 6, 7.

The best specimens at Station 6.

484. *Globigerina helicina*, d'Orbigny.

Globigerina helicina, d'Orbigny, 1826, TMC. p. 277, no. 5.
.. .. Cushman, 1910, etc., FNP. 1914, p. 12, pl. iii, figs. 1, 2.

Stations 6, 16, 18–20, 22, 23, 27, 36 (+ D.).

The specimens at Station 6 are poor, at the others much more distinctive, especially at Station 18. Brady has already questioned the specific value of this species, which he was inclined to regard as merely a monstrous variety of other species. The evidence from this material strongly supports this. At Stations where *G. helicina* occurs *G. dutertrei* is a predominant form, and nearly all our specimens of *G. helicina* show at least one character characteristic of *G. dutertrei*. Brady's figures, on the other hand, suggest a *G. conglobata* origin.

485. *Globigerina aequilateralis*, Brady.

Globigerina aequilateralis, Brady, 1879, etc., RRC. 1879, p. 285; 1884, FC. p. 605, pl. lxxx, figs. 18–21.
.. .. Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 680.

Stations 2, 3, 6, 7, 12 (+ R. d. J.).

N.Z. area only. Magnificent specimens at Stations 2, 3 and 6, including a spinous pelagic specimen at the latter. Less well developed at Stations 7 and 12. Fossils at Stations 2, 3 and 6 also. (*See* our note under *G. cretacea*, var. *eggeri*, no. 476.)

ORBULINA, d'Orbigny.

486. *Orbulina universa*, d'Orbigny.

Orbulina universa, d'Orbigny, 1839, FC. p. 3, pl. i, fig. 1.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 681.

Stations 1–12, 38 (+ R. d. J.).

Universal in the N.Z. area. A single thick-walled bottom specimen at Station 38. The N.Z. series is very complete and exhibits practically every recorded variation, as regards size, thin-walled pelagic, thick-walled benthic. Double specimens (=*O. bilobata*, d'Orb.) occur at Stations 2, 3, 6. Triple individuals at Stations 3 and 6. At Stations 2, 3, 6, 8 and 11, specimens occur in which the orbuline sphere does not entirely enclose the inner globigerine shell, which projects from the outer surface. In those at Station 2 the globigerine chambers are very coarsely pitted, so that the specimens were at first referred to *O. porosa*, Terquem, which probably owes its creation to such abnormal types as these (T. 1858, etc., FLM. 1858, p. 633, pl. iv, fig. 16).

[Arenaceous isomorph, *Thurammina papillata*, Brady.]

HASTIGERINA, Wyville Thomson.

487. *Hastigerina pelagica* (d'Orbigny).

Nonionina pelagica, d'Orbigny, 1839, FAM. p. 27, pl. iii, figs. 13, 14 (1, 2, in text).
Hastigerina ,, Cushman, 1910, etc., FNP. 1914, p. 15, pl. viii, figs. 1–8.

Stations 3, 6.

A single specimen at Station 3 and many excellent ones at Station 6, all presumably fossils, judging by their appearance.

PULLENIA, Parker and Jones.

488. *Pullenia obliquiloculata*, Parker and Jones.

Pullenia obliquiloculata, Parker and Jones, 1865, NAAF. pp. 368, 421, pl. xix, fig. 4.
,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 681.

Stations 1–3, 6–12, 16 (+ T. d. F.).

Generally distributed in the N.Z area. Very fine specimens at Stations 1, 2 and 6, thin-walled and hyaline. Very thick benthic specimens at Station 7. Benthic specimens sometimes attaining a large size, especially at Stations 10 and 12. Outside the N.Z. area recorded only as benthic at Station 16.

489. *Pullenia quinqueloba* (Reuss).

Nonionina quinqueloba, Reuss, 1851, FSUB. p. 71, pl. v, figs. 31*a*, *b*.
Pullenia ,, Cushman, 1910, etc., FNP. 1914, p. 21, pl. xiii, fig. 2.

Stations 2, 3, 6–8, 10–12, 16–18, 20, 22, 23, 27, 31, 32, 36, 38, 45, 46, 48–50, 52–54 (+ R. d. J.).

Universally distributed and showing no signs of decrease in size or development as we go south. The number of chambers varies between four and seven; in fact at some Stations six-chambered specimens are almost as abundant as the normal type. Best in the N.Z. area at Stations 6, 10, 11 and 12; at the last two Stations there is a tendency to inflation, bringing them very near to *P. sphaeroides*, indeed the four-chambered specimens at these two Stations may be regarded either as compressed *P. sphaeroides* or inflated *P. quinqueloba*. Similar inflated specimens, sometimes with lobulate edge, at Stations 18 and 22. The species attains its best dimensions at Antarctic Stations 36, 38, 45, 48 and 50. Six-chambered specimens at Station 45, 48 and others, and seven-chambered at Stations 38 and 50. Fossil specimens only at Stations 2 and 3, also at Station 6 with excellent recent ones.

490. *Pullenia sphaeroides* (d'Orbigny).

Nonionina sphaeroides, d'Orbigny, 1826, TMC. p. 293, no. 1, Modèle no. 43.
Pullenia ,, Cushman, 1910, etc., FNP. 1914, p. 20, pl. xi, fig. 2.

Stations 3, 6–8, 10–12, 16–20, 22, 23, 29, 36 (+ T. d. F.).

Best in the N.Z. area at Stations 7 and 11, where it is very fine. Outside this area best at Station 16, where it is very large, and at Station 22, where five-chambered specimens occur. Small at most of the other southerly Stations. Compressed individuals at Stations 7, 11, 16, 19, 29 and 36.

SPHAEROIDINA, d'Orbigny.

491. *Sphaeroidina bulloides*, d'Orbigny.

Sphaeroidina bulloides, d'Orbigny, 1826, TMC. p. 267, no. 1, Modèle no. 65.
,, ,, Cushman, 1910, etc., FNP. 1914, p. 18, pl. x, fig. 7; pl. xii, fig. 1.

Stations 1, 3, 6–12, 14, 16, 17, 19, 31, 32, 36, 41, 45, 55.

Generally distributed, but nowhere abundant, except at Station 17, where it is common, but the specimens are small. Stations 10 and 11 are the best, where it is frequent, finely-developed and large. At the remaining Stations the records mostly depend upon a single specimen.

[Arenaceous isomorph, *Haplophragmium sphaeroidiniforme*, Brady.]

492. *Sphaeroidina dehiscens*, Parker and Jones.

Sphaeroidina dehiscens, Parker and Jones, 1865, NAAF. p. 369, pl. xix, fig. 5.
,, ,, Cushman, 1910, etc., FNP. 1914, p. 19, pl. x, fig. 2; pl. xiii, fig. 1.

Stations 6, 7.

Extremely rare, but typical.

FAMILY ROTALIIDAE.

SUB-FAMILY SPIRILLININAE.

SPIRILLINA, Ehrenberg.

493. *Spirillina vivipara*, Ehrenberg. Pl. VII. Fig. 4.

Spirillina vivipara, Ehrenberg, 1841, SNA. p. 442, pl. iii, fig. 41.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 683, pl. li, figs. 19–23.

Stations 2, 4, 6, 31, 38, 45, 47, 53, 55 (+ R. d. J., D.).

Absent from all deep-water Stations, but otherwise generally distributed. At Station 2 specimens attached to stones, and also examples of a curious and pretty variety characterized by a dome-shell with a single row of perforations (?) following the middle line of the tube, giving a decorate appearance to the shell, but otherwise typically *S. vivipara*. This compares in some respects with Chapman's *S. decorata*, var. *unilatera* (C., 1901, etc., FFA. 1902, p. 410, pl. xxxvi, fig. 17). At Station 6 in addition to the best series of the normal type, Rhumbler's var. *revertens* occurs (R., 1906, FLC. p. 32, pl. ii, figs. 8–10), in which the oral end of the tube is imperceptibly turned in and fused with the preceding whorl, so as to show no demonstrable aperture. At the S. Polar Stations 45, 53 and 55, all the specimens represent a convex and dome-like type. At Station 53 one specimen is attached to a Zoophyte, and another free specimen of this type has three young individuals inside the concave base of the shell, each of the young showing a primordial chamber and one complete spiral.

[Porcellanous isomorph, *Cornuspira involvens*, Reuss, and *foliacea* (Phil.). Arenaceous isomorph, *Ammodiscus incertus*, d'Orb., and *tenuis*, Brady.]

494. *Spirillina obconica*, Brady.

Spirillina obconica, Brady, 1879, etc., RRC. 1879, p. 279, pl. viii, fig. 27; 1884, FC. p. 630, pl. lxxxv, figs. 6, 7.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 683.

Stations 2, 6, 26, 31, 53, 55.

Widely scattered records. Remarkably good at Stations 26 and 31, a very fine attached specimen of very decorate appearance, owing to the regular spacing of the perforations along the tube at Station 2. The remaining specimens small.

[Porcellanous isomorph, *Cornuspira polygyra*, Reuss, *fide* Hantken (H., 1875, CSS. p. 19, pl. ii, fig. 1).]

495. *Spirillina obconica*, var. *carinata*, Halkyard.

Spirillina vivipara, var. *carinata*, Halkyard, 1889, RFJ. p. 69, pl. ii, fig. 6.
" *obconica*, " " Heron-Allen and Earland, 1916, FWS. p. 269.

Stations 53, 55.

Several fine examples at our southernmost limit.

496. *Spirillina lucida*, Sidebottom.

Spirillina lucida, Sidebottom, 1904, etc., RFD. 1908, p. 9, pl. ii, fig. 9.
,, ,, Heron-Allen and Earland, 1908, etc., SB. 1911, p. 327; 1913, CI. p. 108, pl. ix, figs. 4, 5.

Station 6.

A single typical specimen

497. *Spirillina ornata*, Sidebottom.

Spirillina ornata, Sidebottom, 1904, etc., RFD. 1908, p. 9, pl. ii, figs. 7, 8.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 684, pl. li, figs. 24, 25.

Station 6.

A single typical specimen.

498. *Spirillina inaequalis*, Brady.

Spirillina inaequalis, Brady, 1879, etc., RRC. 1879, p. 278, pl. viii, fig. 25.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 684.

Stations 2, 6.

Very rare, but typical.

499. *Spirillina tuberculata*, Brady.

Spirillina tuberculata, Brady, 1879, etc., RRC. 1879, p. 279, pl. viii, fig. 28 (see also Siddall, 1878, FRD. p. 49).
,, ,, Brady, 1884, FC. p. 631, pl. lxxxv, figs. 12–16.

Stations 31, 38, 48.

Large and strongly marked specimens at Stations 31 and 38; weaker at Station 48.

500. *Spirillina norae-zealandiae*, Chapman.

Spirillina nora-zealandiae, Chapman, 1909, SNZ. p. 352, pl. xvii, figs. 4, 5.

Stations 1–3, 5.

Very fine examples, especially at Station 1.

501. *Spirillina limbata*, Brady.

Spirillina limbata, Brady, 1879, etc., RRC. 1879, p. 278, pl. viii, fig. 26.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 684.

Stations 2, 3, 26.

A very fine series of recent specimens at Station 2. Less typical at Station 3. A single large individual attached to a Zoophyte at Station 26.

[Porcellanous isomorph, *Cornuspira oligogyra*, Hantken (H., 1875, CSS. p. 20, pl. i, fig. 10).]

502. *Spirillina limbata*, var. *denticulata*, Brady.

Spirillina limbata, var. *denticulata*, Brady, 1884, FC. p. 632, pl. lxxxv, fig. 17.
,, ,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 685.

Station 2.

Among the fine series of *S. limbata*, at Station 2, are forms intermediate between that species and Brady's variety; every stage in the transition is represented.

503. *Spirillina margaritifera*, Williamson.

Spirillina margaritifera, Williamson, 1858, RFGB. p. 93, pl. vii, fig. 204.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 685.

Stations 2, 4, 6.

Very fine examples at Station 2, almost equally good at Station 6.

504. *Spirillina decorata*, Brady.

Spirillina decorata, Brady, 1884, FC. p. 633, pl. lxxxv, figs. 22–25.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 685.

Stations 2, 3, 5, 26, 31, 48.

A very handsome set of specimens, but nowhere strictly typical, except at Station 31, where they are very strong. At Stations 2, 3 and 5 the specimens follow Brady's type, but the convolutions are more embracing on the upper surface, and, when worn away, they exhibit strong crossbars which suggest a sub-division of part of the tube into chamberlets. At Stations 26 and 48 some very large specimens, which represent an intermediate form between *S. decorata* and *S. tuberculata*, the upper surface being more or less normal but tuberculate, and the under surface being so strongly tuberculate that the convolutions are masked. In a few of the examples the markings are almost equally strong on the upper surface.

505. *Spirillina selseyensis*, Heron-Allen and Earland. Pl. VII, fig. 3.

Spirillina selseyensis, Heron-Allen and Earland, 1908, etc., SB. 1909, p. 140, pl. xviii, figs. 6, 7
, (=*restis* Halkyard) Halkyard, 1919, BMB. p. 105, pl. vi, fig. 6; pl. vii, fig. 8.

Station 2.

A single damaged specimen at Station 2, which we refer to the above species in preference to creating a new one, although it differs in some respects from the Selsey specimens. The upper surface resembles *S. limbata*, var. *denticulata*, and the under surface, a closely coiled spiral of rope. In the typical *S. selseyensis* the marginal edge is furnished with a keel which cuts off the spiral marking from the outer circumference of the organism. In the N.Z. specimen there is no marginal keel, and the peripheral edge, as may be seen from our figure, is deeply and regularly grooved.

Sub-Family ROTALIINAE.

PATELLINA, Williamson.

506. *Patellina corrugata*, Williamson. Pl. VII, fig. 5.

Patellina corrugata, Williamson, 1858, RFGB. p. 46, pl. iii, figs. 86–89.
.. .. Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 686.

Stations 2–6, 26, 27, 31, 38, 45–48, 50, 53–55 (+ D.).

Universally distributed except in the deep-water area. Typical, and often abundant, the finest series in the Antarctic area, particularly at Stations 31, 38, 45 and 53. The Antarctic specimens are, as a rule, free from any very high conical forms, such as occur in the N.Z. area, notably at Stations 2, 3 and 6. At Station 6 a single fossil specimen.

At Station 47 a very interesting specimen exhibiting the formation of young shells. The parent is of normal megalospheric type. Viewed from underneath, it is seen that the whole of the chambers except the outer annular ring of chamberlets have been absorbed, and the cavity is occupied by a sub-globular mass consisting of a large number of minute individuals, probably thirty or forty at least, each consisting of part of the initial spiral of the adult shell. This mass of young projects considerably beyond the flat base. There is no sign of any other adult shell having been attached ("plastogamy") as figured by Schaudinn (S., 1895, PF., p. 181, fig. O, p. 185).

507. *Patellina corrugata*, var. *annularis* (Parker and Jones).

Orbitolina annularis, Parker and Jones, 1859, etc., NF. 1860 (vol. vi.), pp. 30, 31.
Patellina corrugata, Carpenter, Parker and Jones, 1862, ISF. p. 230, pl. xiii, figs. 16, 17.
.. .. Chapman, 1907, RFV. p. 134, pl. x, fig. 7.

Stations 2, 3.

At these N.Z. Stations a few individuals referable to the very distinctive multi-annular form which is such a prominent feature of the S. Australian shore-sands. In its most advanced development, as found in such sands, the variety is very striking and hardly identifiable with the normal *P. corrugata*. The N.Z. specimens are smaller and much less distinctive, and at the same Stations other specimens, representing transition-stages between this variety and the depressed scale-like form of the type, occur.

CYMBALOPORA, Hagenow.

508. *Cymbalopora poeyi* (d'Orbigny).

Rotalia squammosa, d'Orbigny, 1826, TMC. p. 272, No. 8.
Cymbalopora poeyi, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 687.

Stations 2, 5, 6.

A single very high-domed specimen of the original type of *Rotalia squammosa*,

d'Orb., at Station 2, but with only three visible chambers at the base, instead of six, as in d'Orbigny's figure. At Stations 5 and 6 a few individuals of the depressed *C. poeyi* type, rather pauperate.

509. *Cymbalopora bulloides* (d'Orbigny).

Rosalina bulloides, d'Orbigny, 1839, FC. p. 98, pl. iii, figs. 2–5.
Cymbalopora bulloides, Heron-Allen and Earland, 1914, etc. FKA. 1915, p. 688

Stations 5, 6.

A single specimen at Station 5, and two at Station 6, all large and belonging to the type with depressed acervuline chambers.

DISCORBINA, Parker and Jones.

510. *Discorbina cora* (d'Orbigny).

Rosalina cora, d'Orbigny, 1839, FAM. p. 45, pl. vi, figs. 19–21.
Discorbina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 690.

Station 2.

Fine fossil specimens only.

511. *Discorbina nitida* (Williamson).

Rotalina nitida, Williamson, 1858, RFGB. p. 51, pl. iv, figs. 106–108.
Discorbina nitida, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 691.

Stations 2–9, 11 (+ R. d. J.).

Very good examples at Stations 3, 5, 6. Budding specimens at Station 6. Fossils at Stations 2 and 6.

512. *Discorbina millettii*, Wright.

Discorbina millettii, Wright, 1910–11, ECM. p. 13, pl. ii, figs. 14–17.
,, ,, Heron-Allen and Earland, 1916, FWS. p. 270.

Station 9.

A single typical specimen.

513. *Discorbina praegeri*, Heron-Allen and Earland.

Discorbina praegeri, Heron-Allen and Earland, 1913, CI. p. 122, pl. x, figs. 8–10; 1914, etc., FKA. 1915, p. 692; 1916, FWS. p. 270; 1916, FSC. p. 50.

Stations 2–6, 11, 32, 40.

Sparingly distributed, but fairly frequent and typical at Station 6.

514. *Discorbina isabelleana* (d'Orbigny).

Rosalina isabelleana, d'Orbigny, 1839, FAM. p. 43, pl. vi, figs. 10–12.
Discorbina ,, Heron-Allen and Earland, 1914, etc. FKA. 1915, p. 692.

Stations 2, 4–6.

Rare, best at Stations 5 and 6. A budding ("plastogamic") specimen at the latter Station.

515. *Discorbina rilardeboana* (d'Orbigny).

Rosalina rilardeboana, d'Orbigny, 1839, FAM. p. 44, pl. vi, figs. 13–15.
Discorbina ,, Heron-Allen and Earland, 1914, etc. FKA. 1915, p. 692.

Stations 4–6, 27 (+ R. d. J.).

Poor specimens, hardly typical, the best at Station 6.

[Arenaceous isomorph, *Trochammina squamata*, J. & P. (?), and *Valvulina fusca*, (Will.).]

516. *Discorbina peruviana* (d'Orbigny).

Rosalina peruviana, d'Orbigny, 1839, FAM, p. 41, pl. i, figs. 12–14.
Discorbina ,, Heron-Allen and Earland, 1913, CI. p. 122, pl. xi, figs. 1–3.

Stations 6, 27 (+ R. d. J.).

The best at Station 27, where it is fairly frequent.

517. *Discorbina rosacea* (d'Orbigny).

Rotalina rosacea, d'Orbigny, 1826, TMC. p. 273, no. 15, Modèle no. 39.
Discorbina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 692.

Stations 1–6, 8, 10, 11, 16, 26, 45, 50, 53, 55 (+ R. d. J., D.).

Universally distributed, the best at Stations 4, 6, and 26. A sessile specimen at Station 6. At Stations 45 and 50 a tendency to the formation of chitinous shells.

518. *Discorbina baccata*, Heron-Allen and Earland.

Discorbina baccata, Heron-Allen and Earland, 1913, CI. p. 124, pl. xii, figs. 1–3; 1916, FWS. p. 271; 1916, FSC. p. 50.

Stations 2, 3, 5.

Recent at Station 5, fossils at Stations 2 and 3. Rare.

519. *Discorbina turbo* (d'Orbigny).

Rotalia (*Trochulina*) *turbo*, d'Orbigny, 1826, TMC. p. 274, no. 39, Modèle no. 73.
Discorbina turbo, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 693.

Stations 2, 3, 5, 6, 26, 53 (+ R. d. J.).

The best at Stations 5 and 6. A budding specimen at Station 6. Fossils at Stations 2 and 3. The most southerly specimen is rather depressed, being intermediate between *D. turbo* and *D. rosacea*.

520. *Discorbina orbicularis* (Terquem).

Rosalina orbicularis, Terquem, 1875, etc., APD. 1876, p. 75, pl. ix, fig. 4.
Discorbina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915 p. 693.

Stations 2, 3, 5, 6.

Confined to the N.Z. area, the best at Station 6. At Stations 1 and 2 the specimens are all strongly limbate.

521. *Discorbina mediterranensis* (d'Orbigny).

Rosalina mediterranensis, d'Orbigny, 1826, TMC. p. 271, no. 2.
Discorbina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 693.

Stations 2–6, 38 (+ K. I.).

Rare in the N.Z. area, but good specimens at Stations 5 and 6, less typical elsewhere. Fossils at Stations 3 and 6. Excellent, and fairly frequent at Station 38.

522. *Discorbina irregularis*, Rhumbler.

Discorbina irregularis, Rhumbler, 1906, FLC, p. 70, pl. v, figs. 57, 58.
,, ,, Heron-Allen and Earland, 1913, CI. p. 120, pl. x, figs. 2–4.

Station 6.

A single specimen of this wild-growing *D. globularis*.

523. *Discorbina globularis* (d'Orbigny).

Rosalina globularis, d'Orbigny, 1826, TMC. p. 271, pl. xiii, figs. 1–4, Modèle no. 69.
Discorbina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 694, pl. li, figs. 36–39.

Stations 2–8, 13, 26, 31, 38, 45–48, 53–55 (+R. d. J., D.).

Universally distributed, but most abundantly and best developed in the extreme south. The specimens from the Stations south of Station 38 are all large, usually of the high-domed irregular type. Abundant both in the free and sessile conditions. At Station 46 a specimen was found living sessile on a small Pycnogonid. Most of the Antarctic specimens are thin-walled, with a tendency to depauperation and chitinous growth. The most noticeable record is that of a single small, thin-walled but quite typical, individual at Station 13 in a depth of 3,003 fms.; with the exception of a few starved Miliolids, it represents the only benthic calcareous organisms found in that gathering, and the depth is enormously beyond any previous record for the species. In the N.Z. area the specimens are less abundant and generally poorly developed, except at Stations 5 and 6. Fossil specimens at several N.Z. Stations and, as with many other species, the fossils are noticeably larger and more strongly developed than the recent individuals.

524. *Discorbina polyrraphes* (Reuss).

Rotalina polyrraphes, Reuss, 1845–6, VBK. pt. i, p. 35, pl. xii, fig. 18.
Discorbina ,, Heron-Allen and Earland, 1916, FWS. p. 272.
,, ,, Wright, 1910–11, BCNI. p. 4, pl. i, fig. 3.

Station 6.

A few typical specimens. This is a species liable to be overlooked on account of its minute size.

525. *Discorbina obtusa* (d'Orbigny).

Rosalina obtusa, d'Orbigny, 1846, FFV. p. 179, pl. xi. figs. 4–6.
Discorbis ,, Cushman, 1910, etc., FNP. 1915, p. 13, fig. 12.

Station 6 (+ R. d. J.).

A few small specimens.

526. *Discorbina valvulata* (d'Orbigny).

Rosalina valvulata, d'Orbigny, 1826, TMC. p. 271, no. 1.
Discorbina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 695.

Station 6.

A far from typical specimen.

527. *Discorbina saulcii* (d'Orbigny).

Rosalina saulcii, d'Orbigny, 1839, FAM. p. 42, pl. ii, figs. 9–11.
Discorbina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 696; 1908, etc., SB. 1909, p. 114.

Station 6.

One small and doubtful specimen.

528. *Discorbina chasteri*. Heron-Allen and Earland.

Discorbina minutissima, Chaster, 1892, FS. p. 65, pl. i, fig. 15.
,, *chasteri*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 697.

Stations 27, 36, 38, 53, 55.

Confined to the Antarctic area and reaching exceptional development at Station 38. Several typical specimens at Station 36 (2,216 fms.). The occurrence of this curious but distinctive little form, so far away from its original locality in British seas, and in such deep water, is noteworthy. No spinous examples (our var. *bispinosa*, H.-A. & E. 1913, CI. p. 129, pl. xiii, fig. 4) occur, although the variety is recorded by Sidebottom from the East Coast of Australia, in 465 fms. (S. 1918, FECA. p. 256, pl. vi, figs. 18, 19), the type being absent in that locality.

529. *Discorbina rugosa* (d'Orbigny).

Rosalina rugosa, d'Orbigny, 1839, FAM. p. 42, pl. ii, figs. 12–14.
Discorbina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 697.

Station 6 (+ R. d. J.).

A few specimens of a rather compressed type.

[Arenaceous isomorph, *Trochammina inflata*, (Mont.).]

530. *Discorbina bertheloti* (d'Orbigny).

Rosalina bertheloti, d'Orbigny, 1839, FIC. p. 135, pl. i, figs. 28–30.
Discorbis ,, Cushman, 1910, etc., FNP. 1915, p. 20, pl. vii, fig. 3.

Stations 3, 4, 6, 8, 31 (+ R. d. J.).

Confined to the N.Z. area, save for a single weak example at Station 31. Very fine series of specimens at Station 6, including both sessile and "plastogamic" or budding individuals. Fossil at Station 3.

531. *Discorbina bertheloti*, var. *baconica*, Hantken.

Discorbina baconica, Hantken, 1875, CSS. p. 76, pl. x, figs. 3 *a*, *b*.
Discorbina bertheloti, var. *baconica*, Heron-Allen and Earland, 1916, FSC. p. 50, pl. viii, figs. 10–12.

Stations 2–6 (+ R. d. J.).

Confined to the N.Z. area. The best examples at Station 6, including sessile individuals, and specimens characterized by excessive limbation of the sutural lines. Similar specimens at Station 5. Fossils at Station 6.

532. *Discorbina rarescens*, Brady.

Discorbina rarescens, Brady, 1884, FC. p. 651, pl. xc, figs. 2, 3, and ? 4.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 700.

Station 6.

Specimens exhibiting wide variation in the development of the carina, and in the degree of inflation of the chambers. Sometimes so flat as to be almost scale-like. A sessile individual also observed.

533. *Discorbina pustulata*, Heron-Allen and Earland.

Discorbina pustulata, Heron-Allen and Earland, 1913, CI. p. 129, pl. xii, figs. 5–7; 1914, etc. FKA. 1915, p. 701, pl. lii, figs. 24–26; 1916, FWS. p. 273; 1916, FSC. p. 50.

Stations 2, 6.

Excellent examples at Station 2. Those from Station 6 apparently fossil.

534. *Discorbina parisiensis* (d'Orbigny).

Rosalina parisiensis, d'Orbigny, 1826, TMC. p. 271, Modèle no. 38.
Discorbina " Heron-Allen and Earland, 1914, etc., FKA. 915, p. 701.

Stations 2, 38, 47, 50, 55 (+ K. I.).

Except for a somewhat doubtful fossil at Station 2 the species is confined to the Antarctic area, where it is fairly frequent at some Stations, but never attains the enormous dimensions that it does at some Arctic Stations which we have examined, or in the Kerguelen Island material referred to in our Appendix B.

535. *Discorbina opercularis* (d'Orbigny).

Rosalina opercularis, d'Orbigny, 1826, TMC. p. 271, no. 7.
Discorbis " Cushman, 1910, etc., FNP. 1915, p. 18, pl. xi, fig. 3.

Stations 2–6, 7.

Very fine examples at Stations 5 and 6. Fossils at Stations 2 and 6 and "plastogamic" at Station 3.

536. *Discorbina pileolus* (d'Orbigny).

Valvulina pileolus, d'Orbigny, 1839, FAM. p. 47, pl. i, figs. 15–17.
Discorbina ,, Brady, 1884, FC. p. 649, pl. lxxxix, figs. 2–4.

Stations 1–6.

Common everywhere, fossils at Stations 2, 3, and 6. This is perhaps the species of *Discorbina* in which budding (or plastogamy) occurs most abundantly. At every Station except Station 4, such pairs occur in profusion, and in every condition from the actual paired shells to disunited specimens in which the whole of the internal septa have been absorbed. There is, in such series, a complete gradation of size in the budded shell from very elementary individuals, to fully-formed tests, and there is a corresponding difference in the proportions of the individuals, a low-domed specimen being often budded from an abnormally high-domed one. (*See* H.-A. 1915, RPF. p. 246, pl. xv, fig. 27.)

537. *Discorbina patelliformis*, Brady.

Discorbina patelliformis, Brady, 1884, FC. p. 647, pl. lxxxviii, fig. 3, pl. lxxxix, fig. 1.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 703, pl. lii, fig. 32.

Stations 1–3, 5, 6.

The best at Station 1. Fossils at Stations 2, 3 and 6. Rare everywhere.

538. *Discorbina calcarata*, sp. nov. Pl. VII, figs. 12–16.

Stations 2, 3, 5, 6.

Test circular, dome-shaped, consisting of two to three convolutions of chambers, six to eight chambers in each convolution. Sutural lines thick, but not limbate, curving. From the extremity of each sutural line extends a solid spine of very variable dimensions; sometimes a mere papillation on the marginal edge of the shell, occasionally strong and markedly projecting. Base flat, excavated in the centre, beaded in radiating lines. Surface matt to rough. Apical chamber usually smooth and polished.

Dimensions:—Width, ·20–·30 mm.; height, ·20 mm.

Resembles *D. imperatoria* (d'Orb.), as figured by Sidebottom (S. 1904, etc., RFD. 1908, p. 13, pl. v, figs. 1, 2) but is less pointed at the apex, flat instead of concave at the base, and more variable in the character of its spines. The Delos specimens have straight sutural lines.

Confined to the N.Z. area. At Stations 2 and 3 the spinous development is much more marked than at Stations 5 and 6. Many fossils, but, owing to the nature of the shell-surface, these are not easy to discriminate.

539. *Discorbina harmeri*, sp. nov. Pl. VII, figs. 9–11.

Stations 2–6, 8.

Test circular, more or less highly domed, rounded at the apex. Very thick-

walled, very finely striate, with lines running radially from the apex to the periphery. Marginal edge acute, with a tendency at Stations 5 and 6 to become carinate. Base, flat with a small central umbilicus studded with beads. About four convolutions of long curving chambers, six to eight in the last convolution. Viewed as an opaque object the dome-shaped glassy shell has a white spiral running round it from apex to base, which, under higher magnification, becomes resolved into a line of tubules extending through the thick wall of the chambers.

Dimensions:—Width, ·32–·37 mm.; height, ·15 mm.

This is one of the most distinctive N.Z. species, and is frequent at several Stations, especially Stations 5 and 6. Budding ("plastogamic"), and a few fossil individuals at Stations 5 and 6. It appears to be most nearly allied to *D. pileolus*, but has many distinctive characteristics.

540. *Discorbina tabernacularis*, Brady.

Discorbina tabernacularis, Brady, 1879, etc., RRC. 1881, p. 65; 1884, FC. p. 648, pl. lxxxix. figs. 5–7.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 704.

Stations 2, 3, 6.

All fossils.

541. *Discorbina disparilis*, sp. nov. Pl. VII. figs. 20–22.

Station 2.

Test compressed, consisting of about two convolutions, eight chambers in the final convolution rapidly increasing in size. Surface coarsely tuberculate. Sutures strongly limbate on the superior side, the sutures and the tuberculation rendering the septation very indistinct. Marginal edge produced into a thick rounded carina. Inferior surface slightly concave, smooth. Sutural lines very indistinct.

Dimensions:—Length, ·38–·42 mm.; maximum breadth, ·30 mm.

The above description is the best possible for a very obscure form represented by two specimens at Station 2. It is difficult to diagnose, owing to the obscuration of all the earlier structure by the tuberculation of the superior surface, and by the fact that the inferior surface, which is plane, is thick-walled and opaque. The number and shape of the internal chambers can, however, be made out by wetting the inferior surface. Its affinities are rather obscure; it may belong to the *D. biconcava* group, but its nearest ally is clearly *D. involuta*, Sidebottom (S., 1918, FECA. p. 255, pl. vi. 15–17), which it closely resembles in its superior and inferior aspects, but from which it differs in the absence of the subsidiary septa which in Sidebottom's specimens subdivide the internal cavity of each chamber. These, however, may be merely structural developments due to the deeper water from which his specimens were obtained.

542. *Discorbina biconcava*, Parker and Jones.

Discorbina biconcava, Carpenter, Parker and Jones. 1862, ISF. p. 201, fig. 32 *g*.
" " Brady, 1884, FC. p. 653, pl. xci, figs. 2, 3.

Stations 2–6.

Very rare and far from typical. Fossils at Stations 3 and 6.

543. *Discorbina wilsoni*, sp. nov. Pl. VII, figs. 17–19.

Stations 23. 38. 48.

Test free, oval in outline, highly convex on the superior, flat on the inferior surface, but sloping inwards to the umbilical apertural opening. Consisting of about two convolutions of chambers, rapidly increasing in size, slightly swollen, separated by limbate sutures rising into sharp ridges, and forming a sharp narrow edge to the shell. Surface of the chambers between the sutural ridges rough, with beads, forming in some instances transverse costae. Colour opaque dull yellowish-white on the superior side, clear and glassy on the inferior, where the sutural lines are obscure. Aperture, a depression on the inferior face of the terminal chamber, bordered by radiating lines, leading down to a depression furnished with the normal discorbine tooth.

Dimensions:—Length, ·32–·37 mm.; breadth, ·27–·32 mm.; height, ·13 mm.

A few specimens only at each Station. They have considerable resemblance as regards the superior face to Brady's *D. ventricosa* (B., 1884, FC. p. 654, pl. xci, fig. 7), but differ entirely from that species in the character of the underside, and of their decoration. Karrer's *Pulvinulina erinacea* (Karrer, 1868, MFKB. p. 187, pl. v. fig. 6), which is an isomorph of *D. ventricosa*, has also a certain resemblance to our species, which may probably be regarded as an isomorph of *P. lateralis*.

544. *Discorbina pulvinoides*, Cushman.

Discorbis pulvinoides, Cushman, 1910, etc., FXP. 1915, p. 23, pl. vi, fig. 3.

Stations 1. 2. 6. 27.

We attribute our specimens to Cushman's species, but with some reservation. His figure is unsatisfactory as it shows no edge-view; he appears to have founded the species upon a single specimen, and does not refer to the peculiar secondary chambers which are indicated in our specimens, especially in the large and typical example from Station 6. These secondary chambers clearly indicate the close relationship of our specimens to *D. lingulata*.

545. *Discorbina lingulata*, Burrows and Holland.

Discorbina lingulata, Burrows and Holland in J. P. & B., 1866, etc., MFC. 1896, p. 297, pl. vii, figs. 33. *a–c*.

Stations 1, 2, 8, 11.

Very fine examples at Stations 1 and 2, but extremely rare. In the deeper water the specimens become depauperate, but retain their characteristic structure.

546. *Discorbina lingulata*, var. *unguiculata*, Sidebottom.

Discorbina lingulata, var. *unguiculata*, Sidebottom, 1918, FECA. p. 255, pl. vi, figs. 12–14.

Stations 2, 3.

At Station 2 a good many examples of this strongly limbate variety. At Station 3 a few which are almost certainly fossils. The only previous record is from the E. coast of Australia (465 fms.).

PLANORBULINA, d'Orbigny.

547. *Planorbulina mediterranensis*, d'Orbigny.

Planorbulina mediterranensis, d'Orbigny, 1826, TMC. p. 280, pl. xiv, figs. 4–6.- Modèle no. 79.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 705.

Stations 3, 21.

A doubtful specimen at Station 3, and a small but unquestionable specimen from Station 21, in 1,714 fms., probably the deepest record hitherto.

548. *Planorbulina acervalis*, Brady.

Planorbulina acervalis, Brady, 1884, FC. p. 657, pl. xcii, fig. 4.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 705.

Station 6.

A single good specimen.

TRUNCATULINA, d'Orbigny.

549. *Truncatulina refulgens* (Montfort). Pl. VII, figs. 23, 28.

Cibicides refulgens, Montfort, 1808–10, CS. vol. i, p. 122, 31me genre.
Truncatulina refulgens, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 704

Stations 1–6, 12, 18, 26–28, 30, 36, 38, 45–50, 53–55 (+ K. I., R. d. J., D.).

Universally distributed, reaching its maximum development in the extreme S., where it attaches itself to every solid organic and inorganic object. The Polyzoa notable at Station 50 are covered with sessile individuals. These sessile specimens are, as a rule, surrounded by a thin layer of mud, from which extend tubes at irregular intervals all round the shell, the object evidently being to convey the protoplasm, under protection, to some distance from the shell. Such tube-bearing specimens are also found in quantity at Station 27. Here, as at many other Stations, where the type is abundant, many of the specimens are seen to be riddled with small circular holes, especially as to the terminal chambers. Whether these are the borings of a parasite, or in the nature of

subsidiary apertures, there is no evidence to show -probably the former. In the NZ. area the species is much less abundant and less strongly developed than in the Antarctic, but good specimens are found at several Stations, notably Station 6, where also a very handsome cultrate, high-domed type occurs with a thick, glassy shell. At Station 48 occurred a large specimen, ·80 mm. in diameter, which we figure (pl. VII, fig. 24), with the terminal chamber broken and revealing a number of viviparous young in the cavity.

550. *Truncatulina lobatula* (Walker and Jacob).

Nautilus lobatulus, Walker and Jacob, 1798, AEM. p. 642, pl. xiv, fig. 36.
Truncatulina lobatula, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 706.

Stations 1–6, 8 12, 16–19, 23, 26, 27, 29, 31, 38, 45, 47, 48, 50, 53 (+ K. I., R. d. J., D.).

Universally distributed, and, except in the deep water, abundant. Every possible variation, including sessile and encrusted specimens at Station 6, one small individual having become encrusted within the arms of a large Tetractinellid sponge-spicule. At a few Stations (8, 9, 26, 29, 31 and 38) the species is characterized by its minute size, for no apparent reason, otherwise the species is constant in maximum size to the farthest South. Some of the best and most strongly built specimens are from Stations between 45 and 50. At Station 11 a specimen with an extremely minute individual encrusted upon the centre of the flat side.

[Arenaceous isomorph, *Nubecularia lucifuga*, Defr., see note to No. 4.]

551. *Truncatulina lobatula*, var. *arenacea*, nov. Pl. VII, figs. 32–35.

Stations 26, 45.

At Station 26 small neat arenaceous isomorphs, comparable in size and development with the hyaline type, as occurring at this Station. One sessile, and one free individual. The test is neatly constructed of fine sand-grains and ferruginous cement. One less typical example at Station 45.

The size is very variable: a typical specimen was ·40 mm. long and ·30 mm. broad.

552. *Truncatulina variabilis*, d'Orbigny.

Truncatulina variabilis, d'Orbigny, 1826, TMC. p. 279, no. 8.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 706.

Stations 2 4, 6, 12, 16, 18, 19, 50, 55 (+ R. d. J., D.).

Abundant down to Station 6. At the other Stations represented, as a rule, by single individuals presenting no particular features. At Station 19 very thin and outspread, at Station 50 an individual of a very massive and thick-walled type, probably derived from *T. refulgens* rather than from *T. lobatula*. The N.Z. specimens are more noteworthy: it occurs both recent and fossil at Stations 2, 3 and 6, and the fossil specimens are perhaps the most interesting series; they

include every conceivable monstrosity, and a number of specimens simulating the structure of widely-separated genera. Many individuals with regularly textularian chambers, others proceeding from textularian to bigenerine, others with acervuline masses. At Stations 2 and 3, in addition to the type of usual truncatuline texture, a form occurs abundantly, both sessile and attached, in which the shell-wall is very finely tubulate, thick and glistening. This type does not occur elsewhere in the gatherings.

[Arenaceous isomorph, *Haplophragmium canariense*, var. *variabilis*, H.-A. & E.]

553. *Truncatulina tenuimargo*, Brady.

Truncatulina tenuimargo, Brady, 1884, FC. p. 662, pl. xciii, figs. 2, 3.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 707.

Stations 2, 3, 6, 8, 12.

A few typical specimens of the keeled type represented by Brady's fig. 3 occur. Fossil specimens at Stations 2, 3, and 6.

554. *Truncatulina tenuimargo*, var. *alto-camerata*, nov. Pl. VII, fig. 24 27.

Truncatulina tenuimargo, Brady, 1884, FC. p. 662, pl. xciii, fig. 2.
,, ,, Sidebottom, 1918, FECA. p. 257, pl. vi, figs. 20, 21.

Stations 2, 3, 6, 7, 11, 12.

The extraordinary variety adumbrated by Brady in his Fig. 2, and figured by Sidebottom (*ut supra*) occurs generally over the N.Z. area, though specimens are rare. Brady's figure represents a transition form between carinate *T. lobatula* and the high conical-chambered Sidebottom figure, and such intermediate specimens, representing all stages of transition, occur at Stations 3 and 6. The variety reaches its maximum development at Station 2, with individuals having as many as eight high conical chambers to the whorl. At Station 6, where it was most frequent, the specimens are much smaller and the cone is less elevated. Beyond Station 6 it gradually dies out, becoming very rare and smaller in the deeper water, and at Station 12 the cone is hardly more prominent than in Brady's figure. All the specimens at Station 7 were dead and discoloured shells. At Station 3 an individual, intermediate between the extreme types, occurs with pustules of solid shell-matter on the low cones of the chambers. Fossil and recent at Stations 3 and 6; the fossil specimens and the recent are identical. Seguenza figures and describes a form as *Discorbina plano-convexa*, having somewhat similar characteristics, but referable by its aperture to *Discorbina*, and it may be regarded as an isomorph (S. 1882, CMM. p. 199, pl. xxi, fig. 2a, b). A somewhat similar form is described and figured by Schwager (S. 1883, ELW. p. 126, pl. xxix, fig. 14) under the name *Truncatulina colligera*, but the chambers are less dome-shaped and prominent.

The size varies greatly, attaining a length of ·70 mm. and a breadth of ·50 mm., with a maximum height of ·30 mm. in the final chamber.

555. *Truncatulina wuellerstorfi* (Schwager).

Anomalina wuellerstorfi, Schwager, 1866, FKN. p. 258, pl. vii, fig. 105.
" " Cushman, 1910, etc., FNP. 1915, p. 34, pl. xii, fig. 3.

Stations 2, 3, 6 12, 17 20, 22, 32, 48.

Generally distributed as far as Station 32. Very abundant at Stations 3, 10, 11. At Station 3 the specimens are very complanate, with a tendency to sinuous chambers. At Stations 17 and 18, where they are small, the type is high-domed.

556. *Truncatulina haidingerii* (d'Orbigny).

Rotalina haidingerii, d'Orbigny, 1846, FFV. p. 154, pl. viii, figs. 7–9.
Truncatulina haidingerii, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 708.

Stations 1 6, 8, 10–12, 50, 55.

Generally distributed in the N.Z. area, and presenting the usual wide range of variation. Cultrate forms at Stations 2, 3 and 6. Glauconitic casts at Station 6. Fossils at Stations 2 and 6. Outside the N.Z. area the form only occurs farthest South, where they are fairly normal and moderately thick-shelled.

557. *Truncatulina akneriana* (d'Orbigny).

Rosalina akneriana, d'Orbigny, 1846, FFV. p. 156, pl. viii, figs. 13–15.
Truncatulina akneriana, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 709.

Stations 1–3, 6 8, 17, 20, 26, 36, 38.

Generally distributed as far as Station 38, where the finest specimens were found.

[Arenaceous isomorph. *Haplophragmium truncatuliniforme*, Chap. (C. 1895, FAS. p. 16, pl. i, fig. 2).]

558. *Truncatulina ungeriana* (d'Orbigny).

Rotalina ungeriana, d'Orbigny, 1846, FFV. p. 157, pl. viii, figs. 16–18.
Truncatulina ungeriana, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 708.

Stations 1–3, 5–12, 16–18, 22, 31, 32, 36, 38, 49, 50.

Almost universally distributed, the best in the N.Z. area at Stations 3 and 6, very small at Stations 9 and 10. The Antarctic specimens do not present any special features. At Station 2 a broken specimen exhibiting the chitinous lining to the chambers.

559. *Truncatulina robertsoniana*, Brady.

Truncatulina robertsoniana, Brady, 1879, etc., RRC. 1881, p. 65; 1884, FC. p. 664, pl. xcv, fig. 4.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 708.

Stations 2, 3, 5, 6, 8, 9, 11, 27, 29.

In the N.Z. area good and typical specimens at Stations 2, 3, and 6,

especially at the last. At Stations 8, 9, and 11 the specimens are extremely minute, hyaline and colourless, but preserving the characteristic configuration of the type. At Station 27 the normal type occurs, but very small, and at Station 29 it becomes even more pauperate and semi-chitinous.

560. *Truncatulina tenera*, Brady.

Truncatulina tenera, Brady, 1884, FC. p. 665, pl. xcv, fig. 11 *a–c*.
" " Heron-Allen and Earland, 1916, FWS. p. 275, pl. xlii. figs. 31–33.

Stations 7, 8, 10–12, 14, 17–19, 23, 41 (+ T. d. F.).

Sparingly represented, but very good and typical.

561. *Truncatulina dutemplei* (d'Orbigny).

Rotalina dutemplei, d'Orbigny, 1846, FFV. p. 157, pl. viii, figs. 19–21.
Truncatulina " Cushman 1910 etc., FNP. 1915, p. 37, pl. xv, fig. 2.

Station 22 (+ T. d. F., D.).

A single specimen.

562. *Truncatulina tumidula*, Brady.

Truncatulina tumidula, Brady, 1884, FC. p. 666, pl. xcv, figs. 8, *a d*.
" " Cushman, 1910, etc., FNP. 1915, p. 38, pl. xv, fig. 3.

Stations 2, 6, 10, 11, 16, 17, 18, 20, 29–31, 36 (+ D.).

Generally distributed as far as Station 36. The number of specimens few, but the form is very apt to be overlooked. Most prominent at Stations 10 and 31; chitinous pauperate specimens at the latter Station.

563. *Truncatulina pygmaea* (Hantken).

Pulvinulina pygmaea, Hantken, 1875, CSB. p. 78, pl. x, fig. 8 (*Truncatulina* in plate).
Truncatulina " Cushman, 1910, etc., FNP. 1915, p. 38, fig. 11.

Stations 7, 9, 10, 18, 20 26, 27, 31 (+ T. d. F.).

The best at Station 18. The specimens are all typical.

564. *Truncatulina praecincta* (Karrer).

Rotalia praecincta, Karrer, 1868, MFKB. p. 189, pl. v, fig. 7.
Truncatulina praecincta, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 709.

Stations 2, 3, 6.

Few in number and not very typical.

565. *Truncatulina cultér* (Parker and Jones).

Planorbulina cultér, Parker and Jones, 1865, NAAF. p. 421, pl. xix, fig. 1.
Truncatulina " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 709.

Stations 2, 3, 6, 7.

Rare but very good specimens, the best at Stations 2 and 3. Fossils at Station 6.

566. *Truncatulina reticulata* (Czjzek).

Rotalina reticulata, Czjzek, 1848, FWB. p. 145, pl. xiii, figs. 7–9.
Truncatulina reticulata, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 710.

Stations 1, 6 (+ R. d. J.).

Very rare at Station 1: exceptionally fine and large specimens at Station 6.

ANOMALINA, Parker and Jones.

567. *Anomalina polymorpha*, Costa.

Anomalina polymorpha, Costa, 1853, etc., PRN. 1856, p. 252, pl. xxi, figs. 7–9.
" " Heron-Allen and Earland, 1915, FKA. p. 712, pl. liii, figs. 2–5.

Stations 2, 3, 6.

Abundant at Stations 2 and 3, and rare at Station 6. As its name implies, this species is exceedingly variable, and the series from Stations 2 and 3 cover practically the whole gamut of variations. The specimens range between thin regular spineless forms, thicker spineless forms practically inseparable from *A. coronata*, normal spinous individuals in which the regular development of the shell is not lost, and wild-growing specimens with abnormal development of the spines and sometimes with accessory chambers. Even the development of the spines does not follow any fixed line, for, in some instances, they are developed from the ends of the strongly limbate sutures and are formed of solid shell-matter, while in others they are developed from the wall of the chambers, occasionally with an aperture at the tip. The development of these particular forms may be observed in the case of shells which have lived sessile upon large sponge-spicules. The surface available for attachment being small, relatively to the size of the organism, an extension of the chamber is seen to be launched out in each direction in the axis of the spicule. Similar specimens have been admirably figured by Chapman (C. 1901, FLC. p. 392, pl. 1).

568. *Anomalina coronata*, Parker and Jones.

Anomalina coronata, Parker and Jones, 1857, FCN. p. 294, pl. x, figs. 15, 16.
" " Cushman, 1910, etc., FNP. 1915, p. 47, pl. xviii, fig. 5.

Stations 3, 6.

Extremely rare. The scarcity of this species, as compared with the abundance of *A. polymorpha* occurring at the same Stations, is very noticeable.

569. *Anomalina ariminensis*, d'Orbigny.

Anomalina ariminensis, d'Orbigny, 1826, TMC. p. 282 no. 2, pl. xiv, figs. 1–3.
" " Cushman, 1910, etc., FNP. 1915, p. 41, pl. xix, fig. 1 (text fig. 49).

Stations 2, 3, 6, 10, 11.

Confined to the N.Z. area. Frequent and variable at Station 6. Rare else-

where. At Station 6 some of the specimens closely approach Sidebottom's *A. sinuosa*, owing to the strong limbation of the sutural lines on the upper surface, but they are altogether more strongly built, and show little indication of the carinate periphery characterizing Sidebottom's species (S., 1918, FECA, p. 258, pl. vi, figs. 22–25). Some of these limbate specimens are granular on the surface between the limbations; there is a tendency in the later chambers to thin out. The limbate form occurs also at Station 10, but the specimens are very small. Fossil examples occur at Stations 2, 3 and 6, exclusively fossil at Station 3, all large and typical.

570. *Anomalina sinuosa*, Sidebottom.

Anomalina sinuosa, Sidebottom, 1918, FECA, p. 258, pl. vi, figs. 22–25.

Stations 11, 12.

Extremely rare. The specimens from Station 11 typical, but weak; at Station 12, limbation strongly developed, but with weak peripheral edge.

CARPENTERIA, Gray.

571. *Carpenteria proteiformis*, Goës.

Carpenteria balaniformis, var. *proteiformis*, Goës, 1882, RRCS, p. 94, pl. vi, figs. 208–214, pl. vii, figs. 215–219.
.. *proteiformis*, Cushman, 1910, etc., FNP, 1915 p. 19, pl. xx, fig. 2; pl. xxi, fig. 1.

Station 6.

Several specimens of a thick-walled type, studded with solid beads of clear shell-matter similar to Chapman's figure. (Proc. Roy. Soc. Viet. vol. xxvi. 1913, pl. xvi, fig. 7.)

PULVINULINA, Parker and Jones.

572. *Pulvinulina repanda* (Fichtel and Moll).

Nautilus repandus, Fichtel and Moll, 1798, TM, p. 35, pl. iii, figs. *a–d*.
Pulvinulina repanda, Heron-Allen and Earland, 1914, etc., FKA, 1915, p. 713.

Stations 1, 2, 5–7, 26, 27.

Sparingly represented and small, except at Station 2, where it is very large and typical. Fossil only at Station 6.

573. *Pulvinulina repanda*, var. *concamerata* (Montagu).

Serpula concamerata, Montagu, 1803 S, TB, Suppl. p. 160 (*fide* Williamson, 1858, RFGB).
Pulvinulina (*repanda* var.) *concamerata*, Cushman, 1910, etc., FNP, 1915, p. 52, pl. xxv, fig. 1.

Stations 2, 3, 6.

Fossils are frequent; the only recent example occurs at Station 6.

574. *Pulvinulina punctulata* (d'Orbigny).

Rotalia punctulata, d'Orbigny, 1826, TMC. p. 273, no. 25, Modèle no. 12.
Pulvinulina punctulata, Heron-Allen and Earland, 1916, CI. p. 134, pl. iv, figs. 20, 21.
" " Cushman, 1910, etc., FNP. 1915, p. 52, pl. xxiv, fig. 1, text fig. 54.

Stations 6, 9.

One sessile specimen at Station 6, and a few small free individuals at Station 9.

575. *Pulvinulina concentrica*, Parker and Jones.

Pulvinulina concentrica, Parker and Jones (MS.), Brady, 1864, RFS. p. 470, pl. xlviii, fig. 14.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 714.

Stations 1–6.

This handsome species is abundant and very variable at the Stations. The largest individuals at Stations 1 and 2. At most of the Stations two distinct types occur, one depressed, with strongly limbate sutural lines, the other a high form with rather swollen chambers, so that the limbate sutures are sunk in sutural depressions. This swollen form is usually smaller than the others, and is covered all over with the characteristic orange-brown tint, which in the normal type is confined to a band round the edge of the chambers. This band may be wholly or partly missing. In a specimen at Station 6 the clear surface of the chambers was mottled with patches identical with the band-coloration, in another the marginal band is so strongly developed that the chamber-surface is reduced to a small square sunk in the middle. Fossils occur at Stations 2, 3 and 6, recognizable by the band-structure, the colour being destroyed.

576. *Pulvinulina auricula* (Fichtel and Moll).

Nautilus auricula, var. *a*, Fichtel and Moll, 1798, TM. p. 108, pl. xx, figs. *a*, *b*, *c*.
Pulvinulina auricula, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 714.

Stations 6 (+ R. d. J., D.).

A good many very fine specimens.

577. *Pulvinulina oblonga* (Williamson).

Nautilus auricula, var. *β*., Fichtel and Moll, 1798, TM. p. 108, pl. xx, figs *d*, *e*, *f*.
Pulvinulina oblonga, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 714.

Stations 2, 6, 8, 9, 11, 16, 48, 53 (+ D.).

Not uncommon, the majority of the specimens small and thin-walled. Practically no difference between the specimens.

578. *Pulvinulina haueri* (d'Orbigny).

Rotalina haueri, d'Orbigny, 1846, FFV. p. 151, pl. vii, figs. 22–24.
Pulvinulina haueri, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 715.

Stations 2, 7, 23.

Very rare. Single specimens at each Station.

579. *Pulvinulina brongniartii* (d'Orbigny).

Rotalia brongniartii, d'Orbigny, 1826, TMC. p. 273, no. 27.
Pulvinulina brongniartii, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 715.

Stations 2, 6, 11, 12, 31.

Rare, and far from typical, the best specimens, and also sessile examples, at Station 6.

580. *Pulvinulina haliotidea*, Heron-Allen and Earland.

Pulvinulina haliotidea, Heron-Allen and Earland, 1908, etc., SB. 1911, p. 338, pl. xi, figs. 6–11; 1913, CI. p. 136; 1916, FWS. p. 276.

Stations 2, 3, 6, 16.

One specimen from Station 16, recent and typical. The species occurs abundantly as a fossil at Stations 2, 3 and 6, and all the specimens are of much greater size than that from Station 16, or any of the European recent examples.

581. *Pulvinulina tumida*, Brady.

Pulvinulina menardii, var. *tumida*, Brady, 1877, FNB. p. 535.
" *tumida*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 715.

Stations 3, 6 (+ K. I.).

Typical fossil examples at the N.Z. Stations.

582. *Pulvinulina canariensis* (d'Orbigny).

Rotalina canariensis, d'Orbigny, 1839, FIC. p. 130, pl. i, figs. 34–36.
Pulvinulina canariensis, Cushman, 1910, etc., FNP. 1915, p. 56, pl. xxiii, fig. 1.

Stations 1–3, 6–8, 10.

Confined to the N.Z. area, frequent and well developed.

583. *Pulvinulina patagonica* (d'Orbigny).

Rotalina patagonica, d'Orbigny, 1839, FAM. p. 36, pl. ii, figs. 6–8.
Pulvinulina patagonica, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 716.

Stations 2, 3, 7, 8, 9, 11 (+ R. d. J.).

Frequent in the N.Z. area. The specimens differ considerably in thickness of shell-wall.

584. *Pulvinulina patagonica*, var. *scitula*, Brady.

Pulvinulina scitula, Brady, 1882, FKE. p. 716.
" " Balkwill and Millett, 1884, FG. p. 85, pl. iv, fig. 12 (revision, p. 4)
" *patagonica*, var. *scitula*, Heron-Allen and Earland, 1916, FSC. p. 51, pl. ix, figs. 2–5.

Stations 3, 6, 8.

The best at Stations 3; very rare. The tangled history of this variety has been fully dealt with by us as above.

585. *Pulvinulina crassa* (d'Orbigny).

Rotalina crassa, d'Orbigny, 1840, CBP. p. 32, pl. iii, figs. 7, 8.
Pulvinulina crassa, Cushman, 1910, etc., FNP. 1915, p. 58, pl. xxvii, fig. 1.

Stations 1–10, 32, 50 (+ T. d. F.).

Universally distributed in the N.Z. area, frequent and well-developed. Fossils at Stations 2 and 6. At the remaining Stations rare and small.

586. *Pulvinulina truncatulinoides* (d'Orbigny).

Rotalina truncatulinoides, d'Orbigny, 1839, FIC. p. 132, pl. ii, figs. 25–27.
" *micheliniana*, d'Orbigny, 1840, CBP. p. 31, pl. iii, figs. 1–3.
Pulvinulina truncatulinoides, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 716.

Stations 1–3, 5–12, 14 (+ T. d. F., K. I.).

The confusion arising between d'Orbigny's two species has been treated from the bibliographical aspect by Millett (M., 1898, etc., FM., 1904, p. 500), but there is also a zoological side which, although a point of minor importance, may be worth referring to. The two species, although unquestionably zoologically identical, represent two different forms of divergent structure. *P. truncatulinoides*, described as a recent type, represents the thin-walled specimens with deeply sunk sutures and umbilical cavity. Such individuals are to be found in shallow-water gatherings wherever the species is recorded: the texture of the shell is always more or less hyaline, and the surface highly papillate under a high magnification. At greater depths the shell-wall thickens, the sutural depressions and the umbilical recess become filled with secondary shell-growth, and the test assumes the more rounded and smoother aspect of the fossil *P. micheliniana*. The difference between the two is a question of shell-thickening, and no doubt individuals of the one type pass in the process of advancing age into the other.

Our specimens illustrate this progress very well. In the shallower N.Z. Stations the open *truncatulinoides* type predominates, the specimens are large, handsome, thin-walled, and typical *truncatulinoides*. With the deeper water, especially at Stations 7–9, thick-walled specimens of the *micheliniana* type predominate. In many of them the sutural depressions and umbilical recess are entirely obliterated.

The best of the *truncatulinoides* type are at Stations 1–3 and 6, the best of the *micheliniana* type at 7–9, 12 and 14.

587. *Pulvinulina umbonata* (Reuss).

Rotalina umbonata, Reuss, 1851, FSUB. p. 75, pl. v, figs. 35, *a–c*.
Pulvinulina " Cushman, 1910, etc., FNP. 1915, p. 60, pl. xxvii, fig. 2.

Stations 8–12, 16, 17, 36.

Rare: the best at Stations 10–12 and 17.

588. *Pulvinulina exigua*, Brady.

Pulvinulina exigua, Brady, 1884, FC. p. 696, pl. ciii, figs. 13, 14.
,, ,, Cushman, 1910, etc., FNP. 1915, p. 60, pl. xxiii, fig. 5.

Stations 6–10, 16–18, 22, 23, 26–28, 31, 36, 45–48, 52, 53 (+ T. d. F., D.).

Common, and universally distributed, the best and largest examples at Stations 8, 9, 16, and 36. This curious little form with a looped aperture is one of the distinctive forms of the "Terra Nova" gatherings, many of the specimens agreeing definitely with Brady's type, others with the starved thin-walled specimens which have so long been associated in British records with *P. karsteni*. Brady, who was first responsible for the addition of *P. karsteni* to the British records (B. 1864, RFS. p. 470; pl. xlviii, fig. 15), must have been quite familiar with these British individuals, and it is extraordinary that he should have copied Reuss's figure of the thick-walled true *karsteni* type to illustrate the comparatively minute British form. The records of the two are probably inextricably mixed. Brady, in recording his new form *P. exigua*, makes no reference to its occurrence elsewhere than in the North and South Atlantic, the Southern Ocean and Pacific, and treats it as an essentially deep-water form.

589. *Pulvinulina pauperata*, Parker and Jones.

Pulvinulina pauperata, Parker and Jones, 1865, NAAF. p. 395, pl. xvi, figs. 50, 51, *a*, *b*.
,, ,, Cushman, 1910, etc., FNP. 1915, p. 61, pl. xxiii, figs. 2, 3, and fig. 58 in text.

Stations 7, 16–19, 22, 23.

With the exception of Station 7, confined to deep-water Stations. Specimens rare except at Stations 16 and 22. At Station 16 it attains a very large size, but the specimens are dead and eroded shells.

590. *Pulvinulina schreibersii* (d'Orbigny).

Rotalina schreibersii, d'Orbigny, 1846, FFV. p. 154, pl. viii, figs. 4–6.
Pulvinulina schreibersii, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 716.

Stations 2, 3, 6 (+ R. d. J.).

Very rare, but large and typical at Station 6.

591. *Pulvinulina procera*, Brady.

Pulvinulina procera, Brady, 1879, etc., RRC. 1881, p. 66; 1884, FC. p. 698, pl. cv, fig. 7.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 717.

Station 1.

A single small but typical individual.

592. *Pulvinulina karsteni* (Reuss).

Rotalia karsteni, Reuss, 1855, KKM. p. 273, pl. ix, fig. 6.
Pulvinulina karsteni, Brady, 1864, RFS. p. 470, pl. xlviii, fig. 15 (after Reuss); 1884, FC. p. 698, pl. cv, figs. 8, 9.
,, ,, Heron-Allen and Earland, 1916, FWS. p. 276, pl. xlii, figs. 34–37.

Stations 1–6, 11, 16, 18, 19, 23, 36 (+ T. d. F.).

Strong, thick-walled individuals of the Reuss-Brady type. Common. The only noteworthy point is the occurrence of typical individuals at the shallow water N.Z. Stations, though there are records in lesser depths. (*See* note to *P. exigua*.)

593. *Pulvinulina elegans* (d'Orbigny).

Rotalia (*Turbinulina*) *elegans*, d'Orbigny, 1826, TMC. p. 276, no. 51.
Pulvinulina elegans, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 717.

Stations 1–3, 6–8, 10, 11, 23, 36 (+ T. d. F., R. d. J.).

Frequent, and well developed at most of the N.Z. Stations, especially Stations 1, 2 and 6. Most of the specimens are of a hyaline texture, even when the walls are thick. Pauperate, thin-walled, compressed specimens at Stations 2 and 3. A thick-walled deep-water specimen at Station 7. At Station 10 a considerable number of very small and very thin-walled individuals. A specimen sessile on a Hydroid stem at Station 2.

594. *Pulvinulina partschiana* (d'Orbigny).

Rotalina partschiana, d'Orbigny, 1846, FFV. p. 153, pl. vii, figs. 28–30, pl. viii, figs. 1–3.
Pulvinulina partschiana, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 717; pl. liii, figs. 12–14.

Stations 6, 7, 10, 11, 12, 14, 36.

This species is biologically inseparable from *P. elegans*. The name has been reserved for the very thick benthic forms of that species. Such individuals occur, typical and well-developed, at Station 7, an interesting series of specimens showing the decomposition of the shell-wall by the separation of the laminae of which it is composed. Similar specimens at Station 11, but less advanced in lamination. A monstrous or double individual at Station 36.

595. *Pulvinulina berthelotiana* (d'Orbigny).

Rotalina berthelotiana, d'Orbigny, 1839, FIC. p. 130, pl. i, figs. 31–33.
Pulvinulina ,, Brady, 1884, FC. p. 701, pl. cvi, figs. 1 *a–c*.
,, ,, de Amicis, 1893, CFP. p. 455, pl. iii, figs. 12, *a–c*.

Stations 1 and 2.

Fine and large specimens. Some very limbate, others almost smooth.

596. *Pulvinulina favus*, Brady.

Pulvinulina favus, Brady, 1877, FNB. p. 534; 1884, FC. p. 704, pl. civ, figs. 12–16.
,, ,, Chapman, 1910, FOF. p. 423, pl. lv, fig. 15.

Station 3.

One fossil, not typical.

ROTALIA, Lamarck.

597. *Rotalia beccarii* (Linné).

Nautilus beccarii, Linné, 1767, SN. (ed. xii), p. 1,162, no. 276.
Rotalia ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 717.

Stations 2, 4–6, 25, 27, 47 (+ K. I.).

The extraordinary rarity of this dominant species is astonishing. At most Stations it is represented by one or two feeble specimens, the best at Station 5.

598. *Rotalia perlucida*, Heron-Allen and Earland.

Rotalia beccarii (*pars*), Balkwill and Wright, 1885, DIS. p. 351.
,, *perlucida*, Heron-Allen and Earland, 1913, CI. p. 139, pl. xiii, figs. 7–9; 1914, etc., FKA. 1915, p. 718; 1916, FWS. p. 277.

Stations 6, 8, 36.

A few typical examples. The description by Reuss of his species *Rotalina nitida* seems to indicate that his form had something in common with ours (R. 1844, KWB. p. 214) but he gives no figure, and the figures published in his later paper (R. 1845–6, VBK. p. 35, pl. viii, fig. 52; pl. xii, figs. 8, 20) are quite unidentifiable.

599. *Rotalia orbicularis* (d'Orbigny).

Gyroidina orbicularis, d'Orbigny, 1826, TMC. p. 278, no. 1, Modèle no. 13.
Rotalia ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 718.

Stations 6, 10, 11 (+ R. d. J., D.).

Many excellent examples at each Station. Brady's figure (pl. cvii, fig. 5) is very misleading, it has nothing in common with d'Orbigny's Model and is clearly a pauperate form of *R. beccarii*, very near *R. perlucida*.

600. *Rotalia soldanii*, d'Orbigny.

Rotalia (*Gyroidina*) *soldanii*, d'Orbigny, 1826, TMC. p. 278, no. 5, Modèle no. 36.
,, *soldanii*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 719.

Stations 2, 3, 5 9, 12, 16–19, 22, 27, 29, 32 (+ T. d. F., R. d. J.).

Universally distributed, and frequent as far as Station 16. From thence it becomes smaller and rarer, and at the most southerly Stations the examples become very small and pauperate. Its maximum development in size at Station

6, where it is common, almost equally good at Stations 8 and 12. In the N.Z. area, especially at Stations 2, 3 and 6, a variety occurs in which the involution of the earlier whorls is carried to such an extent that the final chamber overlaps and gives a nonionine appearance to the test. Fossils of the type occur at Stations 2, 3 and 6.

601. *Rotalia soldanii*, var. *arenacea*, nov. Pl. VII, figs. 29-31.

At Station 28 a specimen, which we figure, built up of fine sand-grains with ferruginous cement. The aperture is large and gaping. Surface-texture neat and smooth, but without excess of cement. Its nearest ally, in the Lituolidae, would probably be *Haplophragmium glomeratum*, with which it agrees in the number and method of arrangement of chambers, but differs in the dissimilarity of the axial extremities, one being drawn out as in *H. glomeratum*, the other being flattened and depressed as in the rotalian type. Brady, in his description of *H. glomeratum*, appears to have met with similar specimens, as he refers to asymmetrical specimens, having one end broader than the other, and with excavated umbilici.

We have similar specimens from Annam.

Size :—Breadth, ·40 mm. ; height, ·30 mm.

602. *Rotalia papillosa*, var. *compressiuscula*, Brady.

Rotalia papillosa, var. *compressiuscula*, Brady, 1884, FC. p. 708, pl. cvii, fig. 1 ; pl. cviii, fig. 1.
.. .. Cushman, 1910, etc., FNP. 1915, p. 70, pl. xxx, fig. 1.

Station 2.

A few fossil specimens.

603. *Rotalia craticulata*, Parker and Jones.

Rotalia craticulata, Parker and Jones, 1865, NAAF. pp. 387, 122, pl. xix, fig. 12.

Station 6.

A few specimens, mostly fossil, which are referable to this species, which, judging from its markings and their occurrence at the Station where *R. clathrata* reaches its maximum development, is probably a pauperate form of that species.

604. *Rotalia clathrata*, Brady.

Rotalia clathrata, Brady, 1884, FC. p. 709, pl. cvii, figs. 8, 9.
.. .. Jones and Chapman, 1900, MCI. p. 232, pl. xx, fig. 2.

Stations 2 8, 10, 11.

Common in the N.Z. area and reaching its maximum development and variation at Station 6. The species varies enormously in the relative convexity of the two faces, and the degree of strength of the costae traversing the walls of the chambers. In its most compressed form the superior face is absolutely flat and the inferior but slightly convex. Such specimens are only separable externally

from *Polystomella verriculata* by the character of their markings, and when the costae become intricate or labyrinthic, as they sometimes do, the only distinction observable is the apertural edge and the nature of the orifice. South of Station 6 the species dies out, becoming less abundant and characteristic. At its final Station, 11, it has lost all regularity of costation, and the few weak individuals are covered with a reticulate mesh. Many natural glauconitic casts at Station 6. These reveal the presence of an intricate secondary canal-system.

Sub-Family TINOPORINAE.

GYPSINA, Carter.

605. *Gypsina inhaerens* (Schultze).

Acervulina inhaerens, Schultze, 1854, OP. p. 68, pl. vi, fig. 12.
Gypsina inhaerens, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 724.

Stations 1–3, 6, 10.

Confined to the N.Z. area. Abundant and extremely variable, both in size of specimens and of the constituent chambers. The best series covering all possible variations, both free and sessile at Station 6. Almost equally good at Stations 1 and 2. The species incrusts stones and organisms of every description.

[Arenaceous isomorph, *Trochammina uviformis*, Grzyb., and allied forms.]

606. *Gypsina vesicularis* (Parker and Jones).

Orbitolina vesicularis, Parker and Jones, 1859, etc., NF. 1860, p. 31, no. 5.
Gypsina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 726.

Stations 1–3, 5, 6.

Much more abundant than *G. globulus*, and often very nearly passing into that form. The best at Stations 1 and 5, attached specimens at Station 2.

607. *Gypsina globulus* (Reuss).

Ceriopora globulus, Reuss, 1847, Haidinger's Naturw. Abh., vol. ii, p. 33, pl. v, fig. 7.
Gypsina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 727.

Stations 1, 5, 6.

Rare, but good. One very large specimen at Station 6.

POLYTREMA, Risso.

608. *Polytrema miniaceum* (Pallas). Pl. VIII, figs. 1–31.

Millepora miniacea, Pallas. Elenchus Zoophytorum. (Hague, 1766), p. 251.
,, ,, Linné, 1788, SN. p. 3,784, no. 6.
,, ,, Defrance, 1824, Dict. Sci. Nat., vol. xxxi, p. 82.
,, ,, Blainville, 1834, Manuel d'Actinologie, p. 410.
Polytrema ,, Carpenter, Parker and Jones, 1862, ISF. pp. 228, 235, pl. xiii, figs. 18–20.
,, *miniaceum*, Carter, 1870, HR. pp. 389–392; 1876, P. p. 185, pl. xiii, figs. 1–6; 1879, NF. p. 411.

Polytrema	*miniaceum*.	Möbius, 1880, FM. p. 85, pl. vii.
..	..	Brady, 1884, FC. p. 721, pl. c, figs. 5-9, pl. ci, fig. 1.
..	..	Schlumberger, 1892, FAM. p. 196, fig. 5.
..	..	Chapman, 1899, FFA. p. 16, pl. iv, fig. 7.
..	..	Merkel, 1900, Beiträge zur Kentniss des Baues von *Polytrema miniaceum*, Zeitschr., f. wiss. Zool. Bd. lxvii, pp. 291–322, pls. xvi, xvii.
..	..	Sidebottom, 1904, etc., RFD. 1909, p. 11, pl. iv, fig. 7.
..	..	Hickson, 1911, P. (*entire paper*), pls. xxx–xxxii.
..	..	Heron-Allen and Earland, q.v. *re* Risso. 1914, etc., FKA. 1915, p. 728.
..	..	Cushman, 1919, RFNZ. p. 632.
.	..	Heron-Allen and Earland, 1920, V.P., p. 165; 1922, Bull. Soc. Sci. Hist. and Nat. Corse. (Bastia, Corsica). *In the press.*

Stations 1–6.

The abundance of this species in the N.Z. area, and especially at Station 2, where practically every solid organism is more or less covered with it, has enabled us to make a noteworthy contribution to the large body of facts which have already been recorded about this genus, and our observations have been amplified by the examination of an unlimited supply of material from the "sables rouges" of Ajaccio (Corsica) which seemed to us to promise so much light upon the subject that we proceeded thither for the purpose of collecting and studying the organism. Our journey was amply repaid.

Early "Free" Stage.—Carter, in 1876 (P., p. 196), in referring to "one mounted, rounded, embryonic specimen from Mauritius," appears to have anticipated Schlumberger in the discovery of the free stage in the life-history of this organism, but, beyond this brief statement, does not seem to have followed the matter up. Schlumberger (*ut supra*) describes, and figures a transverse section of, the free organism: he states that "it shows three spherical chambers with their walls traversed by a few perforations, and arranged like the embryonal chambers of a *Globigerina*, except that one cannot demonstrate any special opening between one chamber and another. Around these three chambers it forms, irregularly, a covering layer of chambers of all shapes and sizes. They have thick walls traversed by strong perforations which increase in diameter from the interior to the exterior. The succeeding (outer) chambers are often drawn out into points, incorporating sand-grains in their walls, and end by fixing the embryo to some submarine body." In our experience the feature of the drawn-out chambers is rare, but we have admirable examples from Ajaccio. This free stage was described and figured again by Sidebottom from Delos (*ut supra*.).

The abundant supply of free individuals placed at our command enables us to make some additions and corrections to the foregoing. The smallest specimens observed in the free state (Figs. 1–3) are flattened and consist of four chambers, two of them of comparatively large size, apparently connected with one another by an intermediate neck, and having two smaller chambers filling up the curves (equitant) between the neck and the two larger chambers. The whole organism

is thus cruciform in shape, with the angles rounded off. No external aperture is, as a rule, visible at this stage, but at Station 3 a four-chambered individual with a slit-like aperture was found. The peripheral walls are rather thick, but are thinner on the flattened faces. In the next stage a fifth chamber is added between two of the chambers of the "cross," and the shell now attains a distinctly rotaline appearance, and has a characteristic rotaline slit-like aperture. Successive chambers are added, at first in a regular spiral (as figured by Merkel) and subsequently irregularly, so as to surround the whole test, which becomes roughly globular with projecting spherules—like a raspberry (Figs. 4–7); and, if this stage of growth continues, tends to become more or less irregular and *Gypsina*-like in form. How long this free stage of existence may continue, in the event of the creature not attaining a congenial host, we cannot say, but some of our specimens—especially from Ajaccio—are considerably larger than the normal size of the individuals passing into the next, or attached, stage.

So far as we are aware, no one has yet described or illustrated the actual method of attachment. Our large series of N.Z. and Corsican specimens has made this quite clear. The free organism settles upon some suitable object; from its under surface it projects protoplasm and forms a thin layer of incrusting chambers connecting it with its host. At this stage (Figs. 8, 9) the method of attachment is not visible round the edges of the young shell, but is easily verified by detaching the individual, or it may be demonstrated in the cases of specimens which have become attached by these delicate connecting chamberlets, and have subsequently broken away again. From these earliest basal chambers the protoplasm then streams out round the spherical embryo, and commences to build an investing wall of chamberlets rising round the edges and sides and finally creeping over and enveloping the young individual, as a dome—or nipple shaped—"house" (Figs. 11–18) from which the development of further chambers proceeds, ultimately extending into those branching arms which complete the type (Figs. 19, 21, 22). All stages in this process have been observed in the material at our command.

It must not be understood from the foregoing that we regard this as the only, or possibly even the most usual, development of *Polytrema*. In our material the species occurs literally by millions; and under such conditions young, free specimens would be expected to occur in similar abundance, but in point of fact, while in the Corsican material the free stage is extremely common, in the N.Z. material, though a large quantity was very carefully examined, the total number of specimens of this free form was probably under 150. On the other hand, if a series of detached adult individuals is examined, many specimens will be found exhibiting a few central rotaline chambers exposed on the flat base. Our observations of the attachment of the free form show that a layer of small chamberlets is interposed between the "raspberry" stage and the point of

attachment, and these, coupled with the outer chamberlets of the free form, constitute a basal layer sufficiently thick to mask entirely the rotaline arrangement of the free form. It seems probable that an alternative method of growth is for the young individual to settle direct as a primordial chamber on its host, and then to construct a minute rotaline test, which, until masked by the superimposition of chamberlets, would be indistinguishable from a young sessile specimen of *Truncatulina* or *Discorbina* (Fig. 29).

Adult "Sessile" Stage.—Throughout these early stages the shell-wall is very thin and delicate, exhibiting the characteristic tubulation of *Polytrema* very distinctly. With advancing growth many of the specimens become very thick-walled, owing to the deposition of shell-matter in solid layers, or as tubular outgrowths from the surface. These outgrowths of shell-substance are usually of a much deeper tint than the surrounding test. The continual formation of thin investing layers of chambers leads to the formation of deeply sunken pits, more or less circular in outline (Fig. 26). In many of these pits or "craters" the circular floors are seen to be finely tubulated, suggesting, at first sight, an attribution to *Homotrema*, Hickson, instead of to *Polytrema*, but the persistent tubulation of the high ridges surrounding these craters is characteristic of *Polytrema*, and there can be no doubt but that these sunken circular patches represent the initial stages of development of the "pillar-pores" marking the genus, and that their origin is due to the spreading of a new stratum of protoplasm over the previously formed shell in an alveolar layer instead of in a solid film. We have observed similar specimens from other localities. No specimens of *Homotrema* were found in either the "Terra Nova" or the Corsican material, and its distinctive characters are such that it could not be overlooked.

The occurrence of siliceous spicules inside the chambers has furnished material for many controversies in the past. Carter (1870 and 1876) who had a highly critical mind, and was also a Sponge specialist, and Schultze before him had no doubt whatever in attributing their occurrence to the inception of the spicules by the organism, either as food or as "ingesta," which by accident have been drawn in by the pseudopodia and have accumulated like the hairs forming the "hair-ball" in an ox's stomach. The N.Z. specimens are not so spiculiferous as those from other localities which we have examined, but an amount of this material was worked out which satisfies us that the adventitious character of the spicules is beyond question. They are usually confined to the apertural arms and the external layer of chamberlets, and they represent forms characteristic of widely separated groups of Sponges, usually Monaxonid, but occasionally Tetractinellid. The curious sickle-shaped flesh-spicules characteristic of some sponges have been identified. When the spicules are small they are often quite perfect, but larger spicules are usually more or less broken. Diatoms, Radiolaria, and other minute organisms are also found ingested in the chambers.

Whether there is any true symbiosis between *Polytrema* and Sponges we are unable to say, but specimens have been found in which the whole of the outer surface was furry with minute projecting spicules. The Sponge, if incrusting the *Polytrema*, must have been in an infinitely thin layer; it seems possible therefore that the sponge-tissue and the protoplasm of the *Polytrema* may have been intermingled under the outer shell-surface. Other specimens were seen in which a Sponge with large, strong, projecting spicules was living in association with *Polytrema*, at any rate to the extent that the two organisms were close together and approximately the same size (Fig. 31). With such a rapidly-growing organism as *Polytrema* it is fairly evident that at the next stage the spreading chambers would envelop the Sponge. If symbiosis did not then occur, the large number of strong spicules enclosed in the *Polytrema* would be analogous to those highly-spiculiferous specimens which have occasioned so much controversy in the past.

Several specimens exhibit evidence that the greater part of the internal structure has been eaten out by another organism, leaving a more or less spherical cavity. Of the nature of this enemy we have no evidence, but, starting from the surface of the trunk it apparently tunnels into the thickest part of the shell, often hollowing out the interior of the trunk right down to the base (Figs. 23, 24).

Polytrema, like most, if not all, other Foraminifera, has a chitinous membrane lining the shell-wall. This is exceptionally thick in the earliest (Figs. 27, 28, 30), and consequently the oldest, chambers, becoming very delicate in the extended arms.

The general form of the N.Z. specimens is erect and branching, but depressed and squamous forms, so common in the Mediterranean, also occur. The colour is pale; no highly-coloured individuals were observed. It varies from pale pink to very faint flesh-colour, practically indistinguishable from the var. *alba* (Carter). The nature of the preservatives employed may be partially responsible for this.

As above indicated, the exhaustive examination of the Corsican material has served to confirm all the points upon which we have laid stress in discussing the "Terra Nova" material, including the normal occurrence of a microspheric type commencing its existence as a minute sessile truncatuline individual. The Corsican material presents several minor points of distinction as compared with the "Terra Nova" gatherings.

1. The early free stage is much more abundant and the individual specimens attain a much larger size and more advanced development than in N.Z.

2. The colour variation is much wider, ranging between the most vivid blood-red and pure white. This may be partly due to the freshness of the Corsican material, as the colouring matter of *Polytrema* is unquestionably more or less fugitive.

3. The Corsican specimens are of a more massive type than those from N.Z., and delicately branching individuals are comparatively rare. This is probably

due to the greater depth of water in the N.Z. area. We were interested to observe that the Corsican specimens suffered from the depredations of an identical or similar enemy, many of them being completely riddled with holes and tubular borings. They are probably the work of minute Annelids or Crustacea, which live on the protoplasm of the *Polytrema*. As to the colouring-matter characteristic of the genus, see page 247.

609. *Polytrema miniaceum*, var. *alba*, Carter.

Polytrema miniaceum, var. *album*, Carter, 1877, CB. p. 213, pl. xiii, figs. 14, 15.
" " " *alba*, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 728.

Station 2.

At Station 2 unquestionable examples, finely branching and in perfect condition, were found. At nearly all the other Stations individuals which in the ordinary course would have been ascribed to this variety, owing to their pale colour, occur. At Station 2 a branching specimen of the variety was found, on the broken terminal of one branch of which a young individual of typical red *P. miniaceum* had settled down to commence its sessile life, encrusting the var. *alba*. At Station 6 a small individual of typical var. *alba* as regards the base, passed into pale *P. miniaceum* in the branching arms; this appears to us to show that the colour is more or less adventitious.

Family NUMMULINIDAE.

Sub-Family POLYSTOMELLINAE.

NONIONINA, d'Orbigny.

610. *Nonionina depressula* (Walker and Jacob).

Nautilus depressulus, Walker and Jacob, 1798, AEM. p. 641, pl. xiv, fig. 33.
Nonionina depressula, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 730.

Stations 1–3, 5, 6, 8–11, 16, 17, 23, 26, 27, 29–31, 33, 36, 38, 45, 47, 48, 50, 52, 54, 55 (+ R. d. J., D.).

Universally distributed and presenting little variation throughout the area, excepting in the deep-water Stations, where the specimens are, as a rule, smaller and more pauperate. At the most southerly Stations, 45–54, the best and most typical series occur. At Station 6, the best in the N.Z area, there is a tendency in many of the specimens to stellate limbation at the umbilicus, giving a superficial resemblance to *N. stelligera*. Fossil examples at Stations 2, 3 and 6.

[Arenaceous isomorph, *Haplophragmium canariense* (d'Orb.) *pars*, = *H. nonioninoides*, Rss. (R. 1862, NHG. p. 30, pl. i, fig. 8).]

611. *Nonionina asterizans* (Fichtel and Moll).

Nautilus asterizans, Fichtel and Moll, 1798, TM. p. 37, pl. iii, figs. *e–h*.
Nonionina " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 730.

Stations 4–8, 10, 54.

Very rare, but good specimens at the early N.Z. Stations. Very minute at Stations 8 and 10. A single individual at Station 54.

612. *Nonionina stelligera*, d'Orbigny.

Nonionina stelligera, d'Orbigny, 1839, FIC. p. 128 pl. iii, figs. 1, 2.
,, ,, Heron-Allen and Earland, 1916, FWS. p. 280, pl. xliii, figs. 8–10.

Stations 3, 6, 7, 9–11, 26, 27, 31, 38, 45, 46, 48, 50, 53–55 (+ D.).

Universally distributed, except at the deep-water Stations. Best at Stations 7 and 10 in the N.Z. area, and at Stations 27, 31, 38 and 50 in the Antarctic. This is a typically Arctic species so far as records go, and its occurrence in similarly high Antarctic latitudes is noteworthy. It is probably the most abundant representative of the genus in the Antarctic, and a similar prevalence occurs in Arctic dredgings from Iceland which we have examined. Extremely rare in temperate tropical seas.

613. *Nonionina umbilicatula* (Montagu).

Nautilus umbilicatulus, Montagu, 1803-8, TB. p. 191; Suppl. p. 78, pl. xviii, fig. 1.
Nonionina umbilicatula, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 730.

Stations 2, 3, 6–12, 16, 18, 19, 22, 23, 29, 49, 50 (+ T. d. F., D.).

Generally distributed; exceptionally good at Stations 6, 7, and 16. At Station 18 the examples are very thick, approaching *N. pompilioides*. Fossils at Stations 3 and 6.

[Arenaceous isomorph, *Haplophragmium canariense* (d'Orb.).]

614. *Nonionina pompilioides* (Fichtel and Moll).

Nautilus pompilioides, Fichtel and Moll, 1798, TM, p. 31, pl. ii, figs. *a–c*.
Nonionina ,, Cushman, 1910, etc., FNP. 1914, p. 25, pl. xvii, fig. 2.

Stations 6, 7, 16, 17, 20, 23.

Good specimens at all the Stations. Its occurrence in such shallow water at Station 6, where excellent recent examples were found, is noteworthy, this being essentially a deep-water form.

[Arenaceous isomorph, *Haplophragmium scitulum*, Brady.]

615. *Nonionina boueana*, d'Orbigny.

Nonionina boueana, d'Orbigny, 1846, FFV. p. 108, pl. v, figs. 11, 12.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 731.

Stations 2–8, 11 (+ R. d. J.).

Confined to the N.Z. area; most abundant at Station 6. Rare and small at Stations 7, 8, and 11. At Stations 5 and 6 there is a considerable range of variation, including inaequilateral individuals comparable with var. *janiformis*, Rupert Jones (J. P. & B. 1866, etc., MFC. 1897, p. 344, Text-fig. 28 *a–c*), but

differing from the Crag specimens in having the acute peripheral edge of the type. In the N.Z. specimen of var. *janiformis* all the chambers are visible on the flattened face, while on the other, the umbilical recess is covered with the strong tuberculations which generally characterize the species in this area.

[Arenaceous isomorph, of var. *janiformis*, *Haplophragmium nanum*, Brady.]

616. *Nonionina scapha* (Fichtel and Moll).

Nautilus scapha, Fichtel and Moll, 1798, TM. p. 105, pl. xix, figs. *d–f*.
Nonionina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 731.

Stations 5–9, 19, 31 (+ R. d. J., D.).

Poorly represented at the Stations. All the specimens are small and pauperate, tending sometimes in the direction of excessive prolongation, approaching *N. sloanii* (O. 1839, FC. p. 46, pl. vi, fig. 8) and others, in the direction of the turgid, evolute form figured by Brady (1884, FC. pl. cix), fig. 16.

617. *Nonionina communis*, d'Orbigny.

Nonionina communis, d'Orbigny, 1826, TMC. p. 294, no. 20.; 1846, FFV. p. 106, pl. v, figs. 7, 8.
,, ,, Terrigi, 1880, SGP. p. 218, pl. iv, figs. 75, 76.

Stations 2, 6, 18, 26, 45, 48, 53.

Very rare. Occasional specimens only.

618. *Nonionina turgida* (Williamson).

Rotalina turgida, Williamson, 1858, RFGB. p. 50, pl. iv, figs. 95–97.
Nonionina turgida, Cushman, 1910, etc., FNP. 1914, p. 29, pl. xv, fig. 3.

Stations 2, 3, 6, 8–10, 26, 27, 31, 48 (+ R. d. J., D.).

Fairly frequent, the best and most abundant at Station 27. In addition to the normal type, a very long form, representing a *N. turgida* variation of *N. sloanii*, occurs at several Stations, particularly at Station 6.

619. *Nonionina turgida*, var. *arenacea*, nov. Pl. VII, figs. 36–38.

Station 26.

A single individual, built up of very fine sand-grains and ferruginous cement Surface smooth, but not polished. Septation very obscure, resembling the hyaline type.

Size :—Length, ·37 mm.; breadth, ·22 mm.; maximum thickness, ·20 mm.

620. *Nonionina pauperata*, Balkwill and Wright.

Nonionina pauperata, Balkwill and Wright, 1885, DIS. p. 353, pl. xiii, figs. 25, 26.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 732.

Stations 4–6.

Perfectly typical specimens at Stations 5 and 6.

POLYSTOMELLA, Lamarck.

621. *Polystomella faba* (Fichtel and Moll).

Nautilus faba, Fichtel and Moll, 1798, TM. p. 103, pl. xix, figs. *a–c*.
Polystomella faba, Heron-Allen and Earland, 1916, FWS. p. 281, pl. xliii, figs. 11–19.

Stations 27, 30.

Several typical specimens.

622. *Polystomella decipiens*, Costa.

Polystomella decipiens, Costa, 1853, etc., PRN. 1856, p. 220, pl. xix, fig. 13.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 732; 1916, FWS. p. 282, pl. xliii, figs. 20–22.

Stations 7, 8.

A few typical specimens.

623. *Polystomella striato-punctata* (Fichtel and Moll).

Nautilus striato-punctatus, Fichtel and Moll, 1798, TM. p. 61, pl. ix, figs. *a*, *b*, *c*.
Polystomella striato-punctata, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 732.

Stations 2, 4–6, 28, 48 (+ R. d. J.).

Singularly rare, but good specimens, especially at the N.Z. Stations.

624. *Polystomella striato-punctata*, var. *selseyensis*, Heron-Allen and Earland.

,, ,, Heron-Allen and Earland, 1908, etc., SB. 1909, p. 695, pl. xxi, fig. 2. Ditto. var. *selseyensis*, *ibid*, 1911, p. 448 (Catalogue). 1913, CI. p. 146; 1914, etc., FKA. 1915, p. 733; 1916, FWS. p. 282.

Stations 2, 50.

Typical specimens, especially at Station 2.

625. *Polystomella subnodosa* (Münster).

Robulina subnodosa, Münster, *fide* Roemer, 1838, CNTM. p. 391, pl. iii, fig. 61.
Polystomella ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 733.

Stations 3–8.

Many excellent examples at Station 6. Rarer and smaller at the other Stations. A few fossils at Station 6.

626. *Polystomella crispa* (Linné.)

Nautilus crispus, Linné, 1767, SN. p. 1162, no. 275; 1788, p. 3370, no. 3.
Polystomella crispa, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 733.

Stations 2, 3, 6, 8.

Minute recent specimens at Station 8. Fossils at the other Stations, small but typical.

627. *Polystomella macella* (Fichtel and Moll).

Nautilus macellus, Fichtel and Moll, 1798, TM. p. 66, pl. x, figs. *e–g*.
Polystomella macella, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 734.

Stations 1–3, 4–6.

Large and excellent recent examples, except at Stations 3 and 4. Excellent fossils at Stations 2, 3 and 6.

Sub-Family NUMMULITINAE.

OPERCULINA, d'Orbigny.

628. *Operculina ammonoides* (Gronovius).

Nautilus ammonoides, Gronovius, 1781, ZG. p. 282, no. 1,220, pl. xix (Fasc. iii, Tab. 2), figs. 5, 6.
Operculina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 737.

Stations 6, 26, 49, 55 (+ K. I.).

Typical and well developed at the two southernmost Stations. Small and weak at the other Stations. This is normally an Arctic form, but it occurs in a pauperate condition all over the world.

V. APPENDIX.

A.—OFF TIERRA DEL FUEGO.

Station. Official list 308.—H.-A. & E., Station 56. See description of the material, *ante*, p. 58.

This small tube of soundings, whilst properly Antarctic, or, rather, coming under our Section 2 (of deep-water Stations between 51° and 72° S.), had it not been from a locality so far away from the group of localities the subject of our Report, would have come between our Stations 13 and 14, being situated in 55° 29′ S., and 78° 54′ W.—"2,356 fms., to the west of Tierra del Fuego."

Being, like Official Station 42, in the nature of an isolated gathering, we have preferred to deal with it separately, like that Station, in an Appendix.

The following species were found at this Station which were not found elsewhere in the material submitted to us. The other species found at the Station are indicated by the letters "T. d. F." after the lists of Stations for the species recorded in the Report.

629. *Aschemonella catenata* (Norman).

Astrorhiza catenata, Norman, 1876, Proc. Roy. Soc., vol. xxv, p. 213.
Aschemonella catenata, Brady, 1879, etc., RRC. 1879, p. 42, pl. iv, figs. 12, 13; 1884, FC. p. 271, pl. xxvii, figs. 1–11; pl. xxvii *a*, figs. 1–3.

One small and not very satisfactory specimen.

630. *Pleurostomella subnodosa* (Reuss).

Nodosaria nodosa, Reuss, 1845–6, VBK, pt. i, p. 28, pl. xiii, fig. 22.
Pleurostomella subnodosa, Cushman, 1910, etc., FNP. 1911, p. 51, fig. 82.

One typical specimen.

B.—ROYAL SOUND, KERGUELEN ISLAND.

"Challenger" Station 149 E., 28 fms.

When we commenced our work on the "Terra Nova" gatherings, and two days before his death, our old friend Sir John Murray gave us a tube of material, labelled as above, which is of interest, for comparison, in connexion with this report. Brady, in 1884 FC., says that only poor specimens of common littoral and shallow-water species were found in it. The examination of the material by Brady and his assistants must have been extremely superficial—the species found by us in 12·5 cm. of washed material number forty-two, four of which were not found by us in the "Terra Nova" gatherings. These are as follows, the other species being indicated in the body of our Report by the letters "K. I." after the lists of Stations for the species recorded.

631. *Miliolina rotunda* (d'Orbigny).

Triloculina rotunda, d'Orbigny, 1826, TMC. p. 299, no. 4.
Miliolina ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 568, pl. xlii, figs. 27–30.

Two good and typical specimens.

632. *Technitella legumen*, Norman.

Technitella legumen, Norman, 1878, GH. p. 279, pl. xvi, figs. 3, 4.
,, ,, Cushman, 1910, etc. FNP. 1910, p. 48, fig. 53.

A small but typical specimen, of which the oral extremity is broken away. This is recorded by Brady from Kerguelen, but not from Station 149 E.

633. *Storthosphaera depressa*, Pearcey.

Storthosphaera depressa, Pearcey, 1900, RCA. p. 37, pl. i, fig. 1.

A single large specimen agreeing very well with Pearcey's description and figure.

634. *Lagena clavata* (d'Orbigny).

Oolina clavata, d'Orbigny, 1846, FFV, p. 24, pl. i, figs. 2, 3.
Lagena ,, Cushman, 1910, etc., FNP. 1913, p. 9, pl. ii, fig. 3.

Two typical specimens, and others, passing into *L. gracillima*.

C.—OFF THE COAST OF RIO DE JANEIRO.

Official Station 42. "Off the Coast of Rio de Janeiro," 22° 56′ S. 41° 34′ W.—40 fms.

Among the material submitted to us for examination was a small jar of organic débris and muddy sand, bearing the above particulars. The organic remains consisted of fragments of large mud-eating worms; these were treated with caustic potash, and a considerable amount of material was thus obtained. There was also a small jar of similar sand, broken shells and minute fishes, obviously rubbish from a trawl-net, bearing no label, and without any indications whatever of locality or depth. On washing this material, it became clear that this also came from Station 42. As this was an isolated gathering, from a locality far removed from those forming the subject of the foregoing Report, we have not recorded the species therein found among our N.Z. and Antarctic records, but we have appended the letters "R. d. J." after the lists of Stations where they were found in those areas. The following nine species call for special mention, not having been recorded elsewhere in this Report.

635. *Biloculina laevis* (Defrance).

Pyrgo laevis, Defrance, 1824, Dict. Sci. Nat., vol. xxxii, p. 273; Atlas Conch., pl. lxxxviii, fig. 2.
Biloculina laevis, Millett, 1898, etc., FM. 1898, p 263.

This so-called species differs from *B. depressa* only in the distinctiveness with which the marginal edge of the penultimate chamber is exposed, running parallel with the peripheral edge of the ultimate chamber, and thus forming a bicarinate test. A single quite typical specimen occurred in this material.

636. *Miliolina auberiana*, var. *arenacea*, nov. Pl. I, fig. 1–3.

Structure exactly as in *M. auberiana*, but the shell is composed entirely of small calcareous sand-grains neatly cemented together. Surface smooth, and dull. Colour grey. Aperture as in the type, but small and furnished with a tooth.

Broken specimens do not reveal any porcellanous lining to the test. The material used as cement appears to be entirely calcareous, effervescing strongly under acid. The variety was quite common in the gathering.

Size: ·50–·70 mm. long; ·50–·60 mm. broad; ·25 mm. thick.

637. *Textularia barrettii*, Jones and Parker.

Textularia barrettii, Jones and Parker, 1863, FJ. pp. 80 and 105.
" " Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 630.

Two very fine specimens.

638. *Cuneolina pavonia*, d'Orbigny.

Cuneolina pavonia, d'Orbigny, 1846, FFV. p. 253, pl. xxi, figs. 50, 52.
" " Carpenter, Parker and Jones, 1862, ISF. p. 193, pl. xii, fig. 17.
Textularia trochus, Goës, 1882, RRCS. p. 80, pl. v, figs. 167–170.
" *barrettii*, Flint, 1899, RFA. p. 285, pl. xxx, fig. 2.
Cuneolina pavonia, Cushman, 1919, FFWI. p. 34, pl. vii, fig. 1.

Some perfect specimens of this very rare and distinctive species. The above are the only records extant.

639. *Bolivina nobilis*, Hantken.

Bolivina nobilis, Hantken, 1875, CSS. p. 65, pl. xv, fig. 1.
,, ,, Cushman, 1910, etc., FNP. 1911, p. 39, fig. 64.

Good and strongly marked specimens, not infrequent.

640. *Cristellaria cassis* (Fichtel and Moll).

Nautilus cassis, Fichtel and Moll, 1798, TM. p. 95, var. *a*, pl. xvii, *a–d*, var. *β* (*et passim*).
Cristellaria cassis, Brady, 1884, FC. p. 552, pl. lxviii, fig. 10.

A single large and very fine example.

641. *Uvigerina tenuistriata*, Reuss.

Uvigerina tenuistriata, Reuss, 1870, FSP. p. 485; and S., 1870, FSP. pl. xxii, figs. 34–37.
,, ,, Cushman, 1910, etc., FNP. 1913, p. 95, pl. xlii, fig. 4.

Two good specimens.

642. *Discorbina tuberculata*, Balkwill and Wright.

Discorbina tuberculata, Balkwill and Wright, 1885, DIS. p. 350, pl. xiii, figs. 28–30.
,, ,, Heron-Allen and Earland, 1914, etc., FKA. 1915, p. 695.

A large and typical specimen. Of this usually small form there are but few records, but it is probably of fairly wide distribution. We have recorded it from Kerimba Archipelago (*ut supra*).

643. *Anomalina foveolata*, Brady.

Anomalina foveolata, Brady, 1884, FC. p. 674, pl. xciv, fig. 1.
,, ,, Egger, 1893, FG. p. 379, pl. xiv, figs. 13–15.

One specimen, becoming somewhat pauperate in the later chambers.

D.—MATERIAL COLLECTED BY THE "DISCOVERY" IN 1901–4.

Apart from the tubes of tow-nettings dealt with on pp. 37–38, the only "Discovery" material submitted to us consisted of a few small tubes containing single specimens in spirit, which had been selected on board the ship, and one tube containing mud.

The picked specimens consisted of *Cyclammina cancellata*, Brady. One large specimen found in trawl January 27, 1902, off "Discovery" Barrier in 300 fms. (mud). *Iridia diaphana*, Heron-Allen and Earland. Many specimens sessile on various objects. Taken Sept. 8, 1903 at 12 hole, Winter Quarters, and in March 1903 at 6 hole, Winter Quarters. The specimens are pauperate and thin, dark in colour, formed of very fine mineral grains and mud. No depths furnished.

Crithionina mamilla, Goës. Many specimens taken Nov. 27, 1902 at Winter

Quarters, 4 hole, 41 fms.; at 12 hole on Sept. 8, 1903, no depth stated; and at 6 hole on Jan. 14, 1903, 130 fms.

All the specimens are similarly built of fine dark grey mud with very long slender sponge-spicules irregularly projecting. Many of these spicules project half an inch or more. They are not sufficiently numerous to bring the specimens into any resemblance to *Crithionina pisum*, Goës, var. *hispida*, Flint. *Miliolina circularis* (Born.) was built into one specimen.

One of the specimens given to us was a fragmentary worm-tube from Winter Quarters, 6 hole, 130 fms. (Jan. 14, 1903, 77° 50′ 30″ S.; 166° 44′ 45″ E.) This was carefully broken up and yielded many species of Foraminifera.

The tube of mud bore the label, Station 270, March 4, 1904, 254 fms. (67° 21′ 46″ S.; 155° 21′ 10″ E.). This, having been washed, yielded about 2 c.c. of material which was relatively rich, giving us 104 species and varieties which we have indicated in our Report by the letter "D," after the list of Stations for recorded species.

Among these were eight that did not occur in the "Terra Nova" material, as follows: –

644. *Hippocrepina indivisa*, Parker.

Hippocrepina indivisa, Parker, 1870, GStL. p. 176, fig. 2.
" " Heron-Allen and Earland, 1913, CI. p. 48, pl. ii, figs. 10, 11.

A small broken individual, lacking the oral extremity, but undoubtedly referable to this species. Very thin-walled, constructed of extremely fine mud with ferruginous cement, deep rust-colour at the aboral point, fading into grey at the broken end. *Hippocrepina* has hitherto been regarded as an exclusively boreal form, and its southern limit, so far, has been in the Moray Firth. Its occurrence even as a single specimen is therefore extremely noteworthy.

644A. *Reophax guttifera*, Brady.

Reophax guttifera, Brady, 1884, FC. p. 295, pl. xxxi, figs. 10-15.
" " Cushman, 1910, etc., FNP. 1910, p. 88, fig. 123.

A single typical specimen.

645. *Bolivina textilarioides*, var. *arenacea*, nov. Pl. IV, figs. 29, 30.

Excellent isomorphs with characteristic bolivine aperture, built up of fine grey and black mineral particles. Many specimens, in some cases having as many as nine and ten pairs of chambers. One individual attached by its aperture to a large sand-grain by means of cement.

Size: –Length, ·20-·30 mm.; maximum breadth, ·13 mm.

646. *Bolivina variabilis*, var. *arenacea*, nov. Pl. IV, figs. 27, 28.

A single specimen, characterized by obscure septation and evenly continuous

marginal edge, appears to be isomorphous with the type. It is built up of coarse sand-grains and the aperture is normally bolivine.

Size :—Length, ·35 mm. ; breadth, ·15 mm.

647. *Lagena distoma*, Parker and Jones, MS.

Lagena distoma, Brady, 1864, RFS. p. 467, pl. xlviii, fig. 6.
,, ,, Cushman, 1910, etc., FNP. 1913, p. 22, pl. xiii, figs. 1, 2.

A single small but typical specimen.

648. *Lagena orbignyana*, var. *alata*, Cushman.

Lagena orbignyana, var. *alata*, Cushman, 1910, etc., FNP. 1913, p. 45, pl. xxiii, fig. 1.

A single small but typical specimen.

649. *Lagena pannosa*, Millett.

Lagena pannosa, Millett, 1895, etc., FM. 1901, p. 11, pl. i, figs. 12–14.
,, ,, Haeckel, 1900–04, Kunstformen der Natur., pl. lxxxi, fig. 3.
,, ,, Sidebottom, 1912, etc., LSP. 1912, p. 398.

A single typical specimen, the neck somewhat more produced than in Millett's figure. The secondary shell-matter is extremely thick ; round the neck, where the secondary layer has been broken away, it extends to a thickness at least double the diameter of the neck on each side. Millett records the species as abundant in the Malay Archipelago and Sidebottom (*ut supra*). There are no other records, but we have specimens from Cebu, in the Philippine Islands (120 fms.).

650. *Lagena auriculata*, var. *costata*, Sidebottom.

Lagena auriculata, var. *costata*, Sidebottom, 1912, etc., LSP. 1912, p. 422, pl. xx, figs. 21, 22 ; 1913, p. 200.

A single typical specimen.

E. WAGNERELLA BOREALIS, Mereseh.

Wagnerella borealis, Mereschkowsky.

Wagnerella borealis, Mereschkowsky, Études sur les Éponges de la Mer Blanche, Mém. Ac. Imp. Sci. St. Pétersbourg, 1878, ser. vii, vol. xxvi, No. 7, p. 22, pl. ii, figs. 1–5.
,, ,, Mereschkowsky, On *Wagnerella*, etc., 1878, Ann. Mag. Nat. Hist. Ser. 5, vol. i, p. 70, pl. vi.
,, ,, Mayer, P., 1879, Zool. Anz. II.
,, ,, Mayer, P., 1881, Zool. Anz. IV.
,, ,, Zuelzer, M., 1909, Archiv für Protistenkünde, 70 Band., pp. 136–202, pl. vi–x.

Although not proper to this Report the occurrence of this remarkable genus of Heliozoa in the "Terra Nova" material is noteworthy and should be recorded.

At Official Stations 194 and 220 (our Stations 26 and 38), off Oates Land, 180–200 fms., *Wagnerella* occurs sessile on Hydrozoa and Polyzoa, and judging from the number of recognizable fragments of the tube which occur in the finest débris is probably abundant at the Station. It was not observed in any other gathering.

So far as we are competent to judge, the specimens do not differ from the figures of Mereschkowsky and Zuelzer, except that in one fragment the long cylindrical tube is densely clad over its whole length with the long spicular bodies which in the published figures are confined to the globular head.

The form was originally described from the White Sea, sessile on Sertulariae and Polyzoa at 2–16 fms. and has since been recorded from shallow water at Naples growing on stones.

No perfect specimens were found, the preparation of the material for our own purposes having been fatal to this delicate organism, but an examination of the preserved Zoophytes would probably lead to the discovery of many individuals.

VI.—LIST OF WORKS REFERRED TO IN THE REPORT.

The number of authorities referred to in the synonymies of the six hundred and fifty species described in this Monograph is so great that it has been necessary to make every effort to economise space. The principle, therefore, first adopted by us in the Clare Island Monograph, has been followed here.

Names of authors, titles of articles, and full bibliographical references to the Transactions and Proceedings in which they are to be found are given in this Bibliography, some lengthy titles being shortened, as follows:

AMNH. = Annals and Magazine of Natural History.
JRMS. = Journal of the Royal Microscopical Society, London.
JQMC. = Journal of the Quekett Microscopical Club, London.
MASIB. = Memorie della Reale Accademia delle Scienze dell' Istituto di Bologna.
QJGS. = Quarterly Journal of the Geological Society, London.
SAWW. = Sitzungsberichte der Kaiserliche Akademie der Wissenschaften Wien. (D = Denkschrift.)

The titles of papers and books are indicated by initials only, after the date of publication, and the first letter of the author's name:—thus, C. 1892, PTC. = F. Chapman, "Microzoa from the Phosphatic Chalk of Taplow," the page, etc., only being given, and all further details being found under that initial and date in the Bibliography. In the case of long or short series of papers, the date of the first is given and the initials are followed by the year in which the paper referred to appeared: thus, M. 1898, etc. FM. 1900 = the papers of Millett's series beginning in 1898, which were published in JRMS. in 1900.

In some cases we have been compelled to fix our own dates arbitrarily—as, for instance, in some of J. Wright's papers, *e.g.*, W. 1885–6, BLP., in which the plate is lettered 1884–5. Brady, when quoting d'Orbigny's Cuba Monograph of 1839, nearly always gave the page in the Spanish edition of 1840. We have invariably given the pagination of the original French edition of 1839. When plates have two numbers, as in some of the Memoirs of the Société Géologique de France, both numbers are given, *e.g.*, T. 1878, FIR. pl. ix (xiv).

Again, much confusion has crept into synonymies by reason of the re-pagination of reprints, a practice which reaches its worst development and results in Parker & Jones' "Nomenclature of the Foraminifera" (P. & J., etc., 1859, etc., NF.) and in Schlumberger's consecutively re-paginated series of Reprints. We have endeavoured in every case to give the original page of the journal in which the papers were published.

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B. 1861, RFS. H. B. Brady.—Contributions to our Knowledge of the Foraminifera. On the Rhizopodal Fauna of the Shetlands. Trans. Linn. Soc. (London), vol. xxiv, pp. 463–475, pl. xlviii.

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B. 1881, HNPE. H. B. Brady.—Ueber einige arktische Tiefsee-Foraminiferen, gesammelt während der österreichisch-ungarischen Nordpol-Expedition in den Jahren 1872–74. DAWW. vol. xliii (1881), pp. 91–110, pls. i, ii.

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B. & M. 1884, FG. F. P. Balkwill & F. W. Millett.—The Foraminifera of Galway. Journ. Microscopy and Nat. Sci. (London), vol. iii, pp. 19–28 & 78–90, pls. i–iv. Revision.—The Recent Foraminifera of Galway, etc., by F. W. Millett (Notes and Corrections, plates re-engraved). Plymouth, 1908.

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[This was reprinted with very slight alterations and additions in the official volume "Deuxième Expédition Antarctique Française (1908–1910) Foraminifères Par E. Fauré Fremiet" (Paris, 1914), 16 pp., 1 pl. The text-figures are redrawn and better reproduced by photo-lithography on the plate.]

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[* This paper is variously referred to as being dated 1849 and 1850. It was read in May, 1849, and all the separate copies were dated on a special title-page 1849, but the volume of which it forms part was issued in 1850 and is so dated.]

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APPENDIX F.

ON THE COLOURATION OF *POLYTREMA MINIACEUM* (PALLAS).

It would have been a source of satisfaction to us had we been able to pronounce definitely upon the chemical constitution of the red colouring matter of *Polytrema*, and we hoped that, with the comparatively ample material afforded by our collection at Ajaccio, we might have arrived at a definite conclusion.

Brady, in 1884 (F.C., p. 720) observed that "a few preliminary experiments suggest that it is an organic substance, and probably identical with that found by Merejkowsky in a large number of marine organisms, and named by him Zoonerythrine." Merkel, however, in his elaborate thesis (*ut supra*, p. 298) states the results of certain researches which he had undertaken, which go to disprove this suggestion. That it is an organic substance there can be no question, for it entirely disappears under heat—like the colouring matter of red coral. Merkel, after setting forth the processes which he employed towards the solution of the question, says:—"I can hardly agree that the red pigment is Zoonerythrin, as to which Merejkowsky and Krukenberg say that it dissolves easily in alcohol and ether. Also, on treatment with a few drops of H_2SO_4, the characteristic blue colour for Zoonerythrin was not observed."

Dr. R. A. Peters has, at our request, carried out a series of careful experiments with a view to determining the nature of the colouring matter at the Biochemical Laboratory at Cambridge. We need not go at length, in this place, into the processes employed, but we append a condensed note kindly furnished to us on the subject.

PIGMENT OF *POLYTREMA MINIACEUM* (PALLAS).

By R. A. Peters, M.D.

Extraction.—The powdered organism is placed upon a small filter paper, in a filter funnel, and extracted with a small amount of dilute acetic acid. The dilute acid is collected in a test tube, and poured back upon the powdered organism until the calcareous matter has dissolved. More acid is added if necessary. A little of the pigment goes into solution by treatment with dilute acetic acid, but the main bulk remains upon the filter paper. Treatment with hot alcohol at this stage may remove some yellow pigment. (If excess alcohol is added, the residue will set to a jelly.) A small amount of hot alcohol, to which a little NaOH has been added, is poured upon the filter paper. This dissolves the bulk of the pigment forming a yellowish red solution. Further treatment with dilute acid as described by Newbigin (J. Phys. xxi. 236, 1897), and then with alcohol led to the solution of some more pigment, but no definite red compound dissolved as described in the case of crustaceorubin. Treatment with strong acid must be avoided, as it breaks down the pigment to a yellow product.

Characters.—An alcoholic solution, when treated with strong H_2SO_4, shows a blue colouration at the junction of the two fluids, identical with the reaction for the lobster pigment and carotin. This indicates a lipochrome. Spectroscopically, in solutions judged to be of equal concentration, the same bands appeared in the unknown pigment and in a solution of the lobster pigment. The main band appeared to extend to 525λ in the concentration used. Attempts to fractionate between alcohol and petrol ether gave no certain result. When fractionated between an aqueous alcoholic solution and petrol ether, the pigment often deposited as a brick-red precipitate between the solvents, which became soluble again upon treatment with alkali.

Solutions in carbon disulphide and chloroform were red, in ether yellow. In alcohol, they were more reddish than a carotin solution of the same concentration, as judged by the tint. Solutions faded rather rapidly.

Discussion.—In general appearance the pigment resembles the crustaceorubin of Newbigin, though its solubility in alkali indicates a difference. There seems little doubt that we have to do with a lipochrome pigment. Owing to the rarity of the organism, the investigation of the pigment upon the scale employed by Willstätter and Stoll (Chlorophyl, 1913) has been clearly out of the question.

Conclusions. The pigment is a lipochrome forming yellowish red solutions in alcohol, and red in chloroform and carbon-disulphide. Spectroscopically it resembles the red pigment of the lobster, but differs from this in certain other respects.

INDEX.

Species found in the three separated gatherings, but not in the main material, or noted in the main Report are indicated as follows :—

T. d. F. = from Station 308 (official list). Off Tierra del Fuego. Appendix A.
R. d. J. = from Station 42 (official list). Off Rio de Janeiro. Appendix C.
K. I. = from Kerguelen Island. "Challenger" Station, 149 E. Appendix B.
D. = from "Discovery" material.

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PLATE I.

		Magn.	No.
Fig. 1.—	*Miliolina auberiana*, var. *arenacea* nov. Front view	75	636
Fig. 2.—	,, ,, ,, Back view	75	
Fig. 3.—	,, ,, ,, Oral view	75	
Fig. 4.—	*Miliolina calcarata* sp. n. Oral view	90	41
Fig. 5.—	,, ,, ,, Front view	90	
Fig. 6.—	,, ,, ,, Back view	90	
Fig. 7.—	*Sigmoilina umbonata* sp. n. Side view	45	53
Fig. 8.—	,, ,, ,, Oral view	45	
Figs. 9, 10.—	*Ophthalmidium margaritiferum* sp. n. Side views	82	58
Fig. 11.—	,, ,, ,, Oral view	82	
Fig. 12.—	,, ,, Side view (Balsam mount)	75	
Fig. 13.—	*Hyperammina ramosa*, Brady, with incorporated specimens of *Cornuspira involvens*, Reuss	45	91
Figs. 14, 15.—	*Vanhoeffenella gaussii*, Rhumbler, showing the protoplasmic body	75	69
Fig. 16.	*Saccammina sphaerica*, M. Sars. Abnormal individual	16	87
Fig. 17.—	*Hyperammina elongata*, var. *tenuissima* nov.	45	95
Fig. 18.—	*Psammosphaera fusca*, Schulze. Sessile individual with tubular extensions	22	84
Fig. 19.—	*Jaculella acuta*, Brady (?) Megalospheric form	11	88
Fig. 20.—	,, ,, ,, (?) Microspheric form	18	
Fig. 21.—	*Hyperammina elongata*, Brady, utilising spicules for construction	23	93
Fig. 22.—	*Ammodiscus shoneanus*, Siddall	75	159

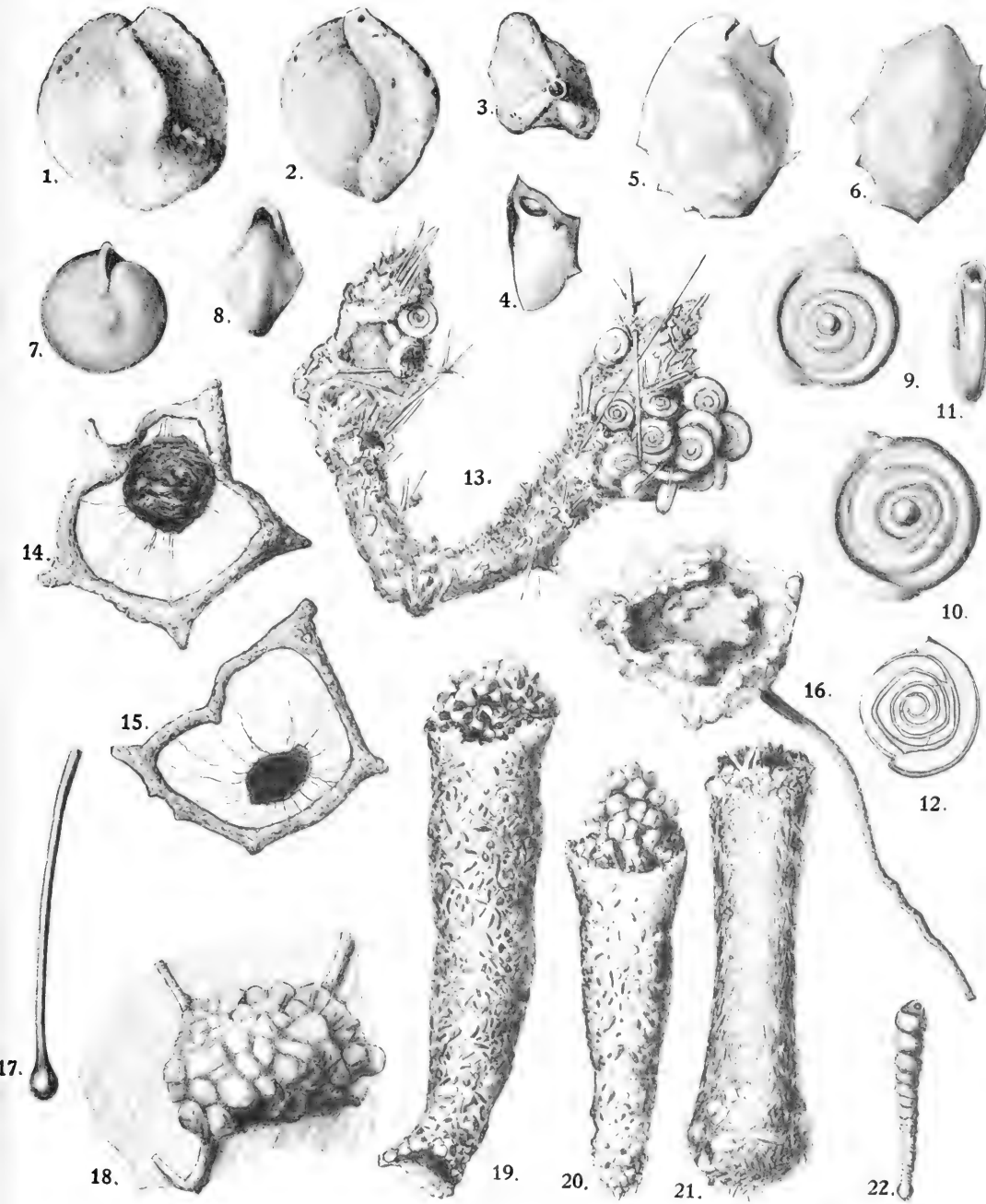
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PLATE II.

DENDRONINA, gen. n.

FIGS. 1–6. *Dendronina limosa*, sp.n. No. 76.

FIG. 1.—A sessile specimen with globular basal chamber and two tubes arising from it (tubes broken).

FIG. 2.—Basal chamber of a free specimen with *cheval-de-frise* of spicules.

FIG. 3.—A young individual showing constriction of tube to form a nipple-shaped aperture (unbroken) and basal spicules.

FIG. 4.—A similar specimen with three trunks, laid open at base to show rudimentary labyrinthic structure.

FIG. 5.—A young individual to show constriction of apertural end of tube (unbroken). The oval bodies are sterrasters of a *Geodia*, and the specimen was probably sessile on the sponge.

FIG. 6.—Superior view of a sessile specimen with irregularly globular basal chamber. The central space shows the line of fracture of a double trunk arising from the basal chamber and indicates the thickness of the wall of the chamber.

FIGS. 7–9. *Dendronina limosa*, var. *humilis*, nov. No. 77.

FIG. 7.—Section showing labyrinthic base, swollen cavity of trunk above it, and simple tube with constricted aperture at the top.

FIG. 8.—Basal view, showing labyrinthic structure.

FIG. 9.—Side view, showing constricted simple aperture at the end of the short trunk.

FIGS. 10–12, 14–18. *Dendronina arborescens*, sp.n. No. 74.

FIG. 10.—A young sessile specimen with regularly formed basal pad and slender trunk (fragment).

FIGS. 11, 16.—Free growing specimens showing the bulbous basal chamber.

FIG. 12.—Semi-diagrammatic restoration of large specimen.

A.—The basal pad; B.—The trunk or principal tube; C.—A secondary tube with terminal corona of spines around aperture; D.—A similar terminal aperture on a branch; E. Branches subdividing into branchlets; F.—Abnormal terminal with spicular extensions.

FIG. 14.—A branchlet characterised by the abnormal size of the spicules employed. Terminal aperture with spicular extensions at the top.

FIG. 15.—A fragment of a branch showing spiral arrangement of spicules.

FIG. 17.—The basal pad viewed as a transparent object. The darker radiating lines indicate protoplasm filling the radiating passages which converge on the central cavity from which the main trunk arises.

FIG. 18.—A branchlet viewed as a transparent object showing the continuity of the protoplasm.

FIGS. 13, 19. *Dendronina arborescens*, var. *antarctica*, nov. No. 75.

FIG. 13.—Detached sessile specimen showing labyrinthic structure of basal pad.

FIG. 19.—The incurved base shows that the specimen was originally sessile, and the broken top end of the trunk suggests a fracture at the point of furcation.

Magn. × 25.

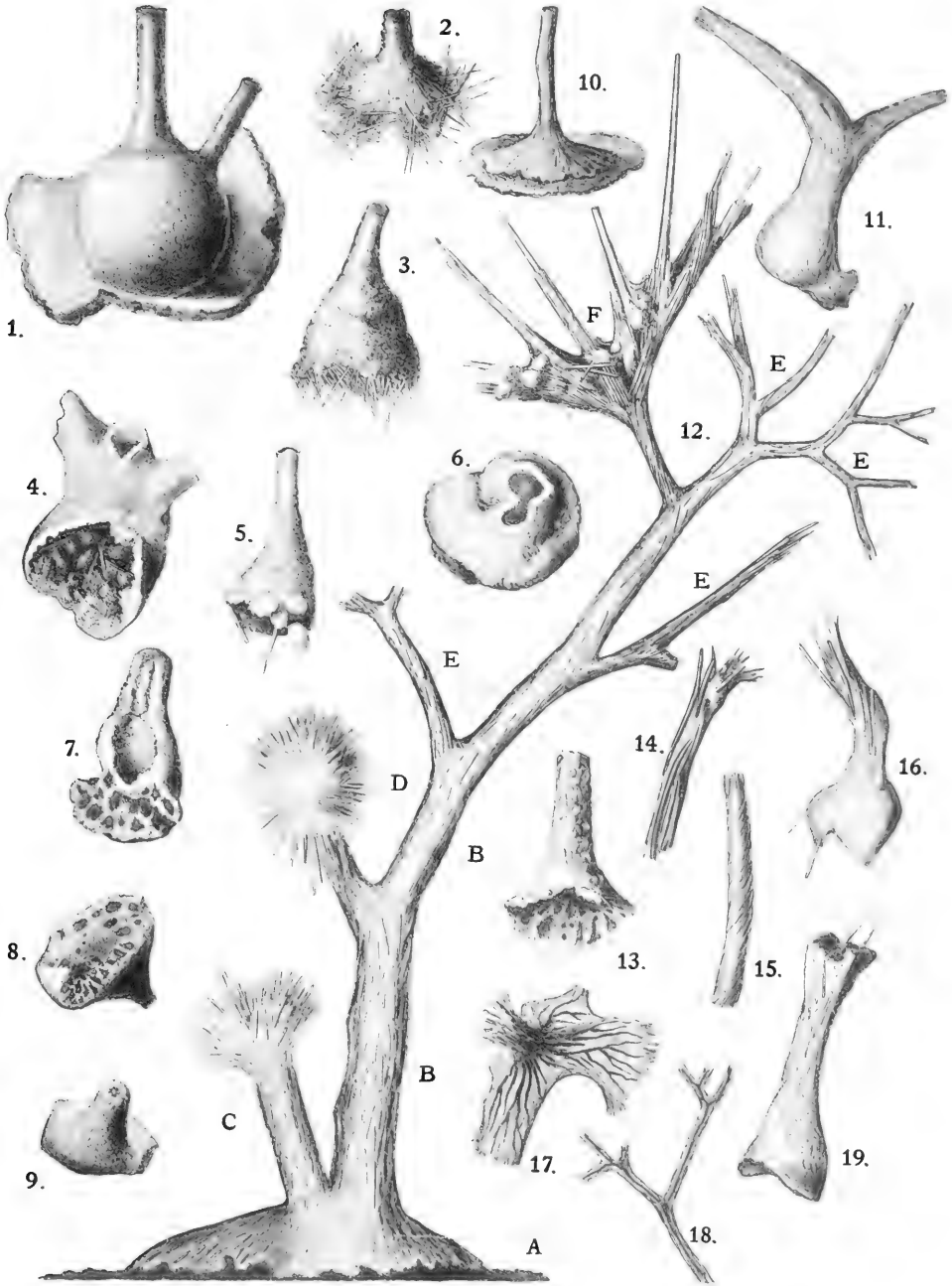
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PLATE III.

		Magn.	No.
Fig. 1.—*Hyperammina novae-zealandiae*, sp.n.	Microspheric	23	96
Figs. 2, 3.— ,, ,, ,,	Megalospheric	32	
Fig. 4.— ,, ,, ,,	,, Balsam mount showing rudimentary septation		
Fig. 5.— ,, ,, ,,	Microspheric. Balsam mount		
Fig. 6.—*Reophax advena*, Cushman.	Straight type, final chamber incomplete.	18	108
Fig. 7.— ,, ,, ,,	Curved type, showing loosely agglutinated final chamber	18	
Fig. 8.—*Marsipella chapmani*, sp.n.		9	99
Fig. 9.— ,, ,, ,,	Balsam mount, showing basal extrusions of protoplasm	9	
Figs. 10, 11, 12.—*Marsipella elongata*, Norman		64	97
Fig. 13.—*Reophax cuneta*, Jensen.	Abnormal specimen with supplementary chambers	16	114
Fig. 14.— ,, ,, ,,	Monothalamous specimen. Balsam mount showing protoplasm	40	
Fig. 15.—*Haplophragmium agglutinans* (d'Orbigny).	Pauperate type	72	118
Figs. 16, 17.—*Trochammina ueiformis*, Grzybowski		54	166
Figs. 18, 19.—*Trochammina monliformis*, sp.n.	Fragments showing aperture	72	165
Fig. 20.— ,, ,, ,,	Unseptate fragment	72	
Fig. 21, 22.— ,, ,, ,,	General aspect of type specimens	72	
Fig. 23.— ,, ,, ,,	Balsam mount	50	
Fig. 24.—*Webbina irregularis*, d'Orbigny		40	174

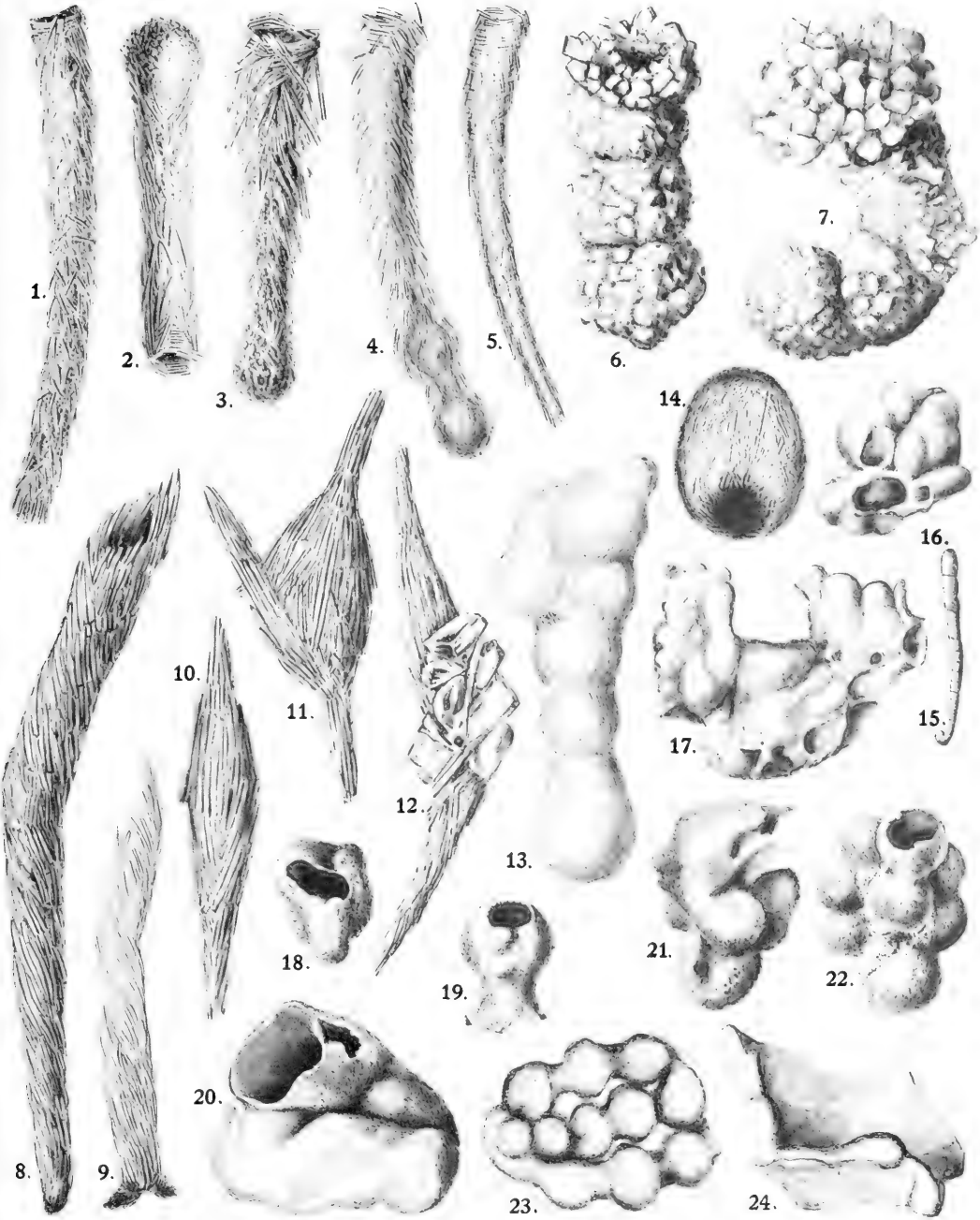
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PLATE IV.

	Magn.	No.
FIG. 1.—*Crithionina lens*, Goës. Sessile. Laid open to show the rudimentary septation	22	147
FIG. 2.— ,, ,, Sessile specimen	22	
FIGS. 3, 4.—*Textularia conica*, var. *horrida*, Egger.	90	190
FIG. 5.—*Crithionina rugosa*, hispid variety.	27	146
FIGS. 6, 7.—*Textularia porrecta*, Brady	27	185
FIGS. 8, 9, 10.—*Verneuilina turris*, sp.n. Side views	70	203
FIG. 11.— ,, ,, ,, Apical view	70	
FIG. 12.— ,, ,, ,, Basal view	90	
FIG. 13.—*Gaudryina ferruginea*, sp.n. Balsam mount	105	200
FIGS. 14, 15.— ,, ,, ,,	90	
FIGS. 16, 17.—*Gaudryina rugosa*, d'Orbigny. Long type	62	197
FIGS. 18, 19.—*Bulimina chapmani*, sp.n. Side views.	45	233
FIG. 20.— ,, ,, ,, Oral view	45	
FIGS. 21, 22.—*Bolivina punctata*, var. *arenacea*, nov.	90	242
FIGS. 23, 24, 25.—*Bifarina porrecta*, var. *arenacea*, nov..	70	240
FIG. 26.— ,, ,, ,, ,, Balsam mount	70	
FIGS. 27, 28.—*Bolivina variabilis*, var. *arenacea*, nov.	90	646
FIGS. 29, 30.—*Bolivina textilarioides*, var. *arenacea*, nov.	135	645
FIGS. 31, 32.—*Bolivina inflata*, var. *arenacea*, nov.	135	254
FIG. 33.— ,, ,, ,, ,, Balsam mount	180	
FIGS. 34, 35.—*Bolivina tortuosa*, var. *arenacea*, nov.	90	259
FIGS. 36, 37, 38.—*Cassidulina subglobosa*, var. *tuberculata*, nov.	90	267

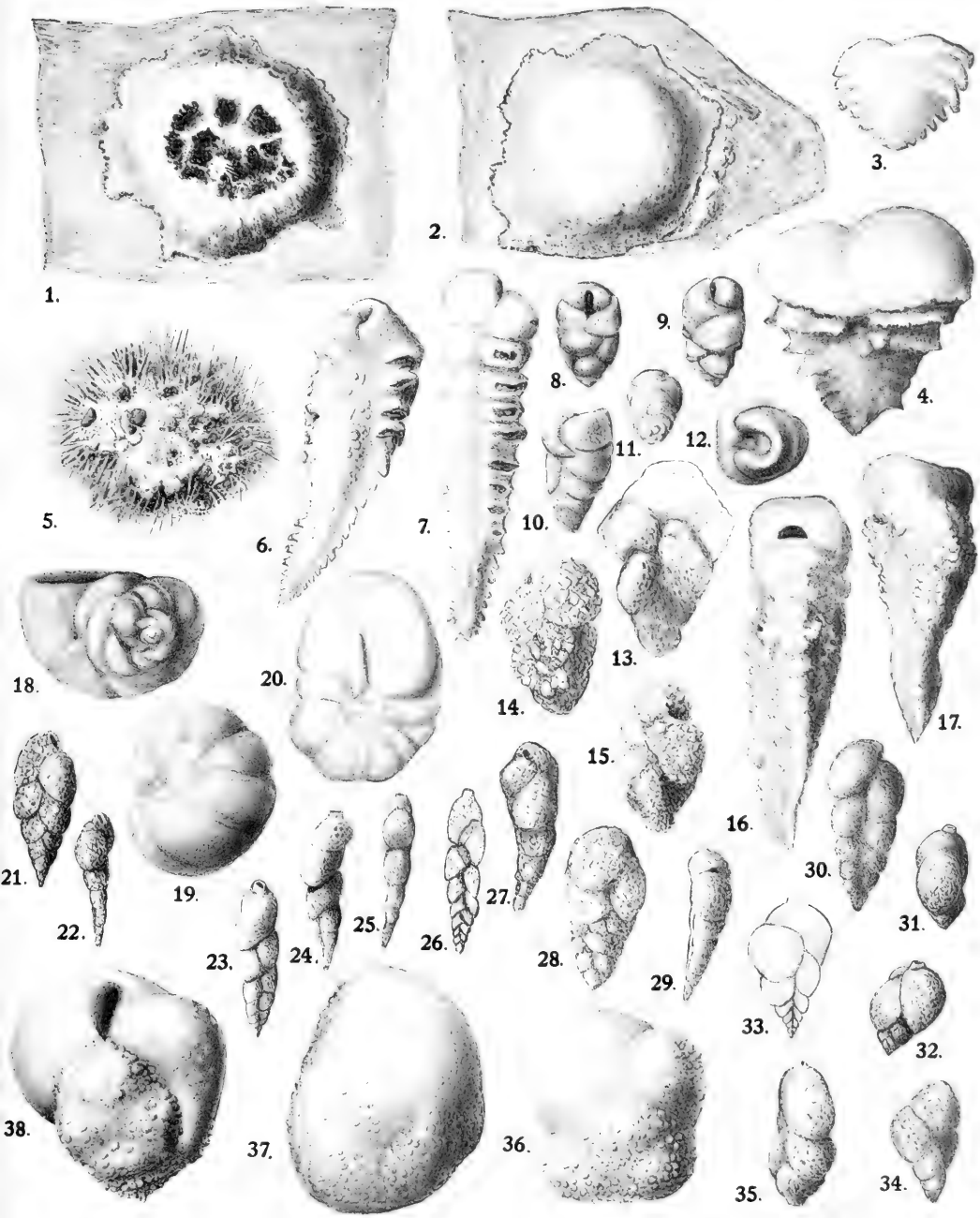
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PLATE V.

		Magn.	No.
Figs. 1, 4, 5.—*Ehrenbergina hystrix*, var. *glabra*, nov.	Oral side views	90	275
Figs. 2, 3.— ,, ,, ,, ,, ,,	Dorsal side views	90	
Fig. 6.— ,, ,, ,, ,, ,,	End view, oral	90	
Fig. 11.— ,, ,, ,, ,, ,,	Abnormal—double shell	75	
Fig. 7.—*Lagena clavulus*, sp.n.		135	292
Figs. 8, 9, 10.—*Cassidulina laevigata*, var. *tumida*, nov.		90	263
Figs. 12, 13, 14.—*Lagena globosa*, var. *lineato-punctata*, nov.		135	280
Fig. 15.—*Lagena squamoso-sulcata*, sp.n.		90	317
Fig. 19. ,, ,, ,, ,,	Oral view	90	
Fig. 16.—*Lagena catenulata*, Reuss.	Oral view	180	319
Figs. 17, 18.—*Lagena catenulata*, Reuss.		180	
Figs. 20, 21, 22.—*Lagena stelligera*, var. *nelsoni*, nov.		140	306
Fig. 23.—*Lagena marginata* (Walker & Boys)	Serrate variety	230	338
Fig. 24.—*Lagena marginata* var. *fissa*, nov..		90	339
Fig. 25.— ,, ,, ,, ,,	Edge view	90	

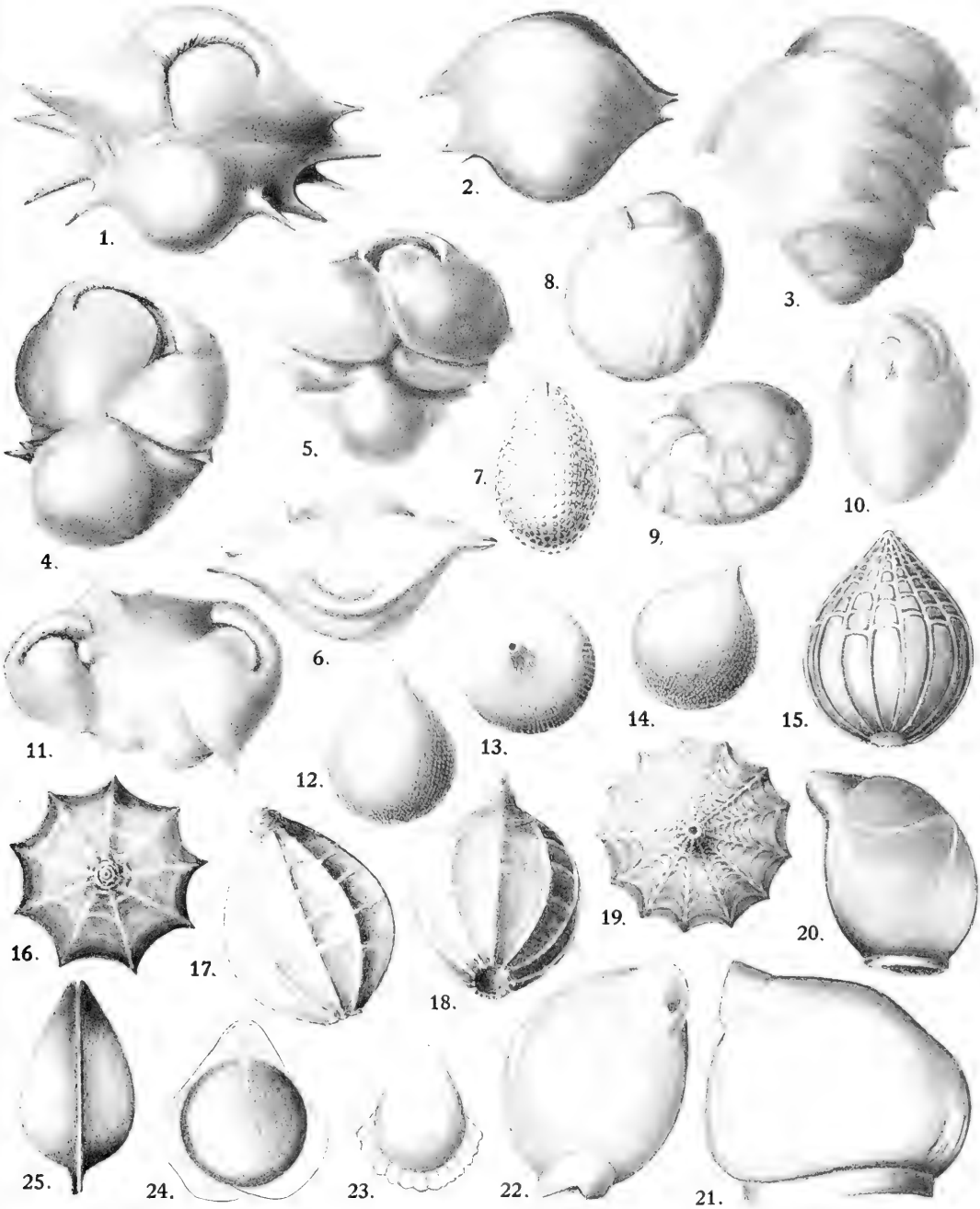
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PLATE VI.

	Magn.	No.
Fig. 1.—*Lagena squamosa*, (Montagu)	135	316
Fig. 2.— ,, ,, ,, Oral view	135	
Fig. 3.—*Lagena scottii*, sp.n.	70	315
Fig. 4.— ,, ,, ,, Detail of surface-ornament	140	
Fig. 5.—*Lagena striatopunctata*, Parker & Jones	62	309
Figs. 6, 7. See under Fig. 11.		
Fig. 19.— ,, ,, ,, Oral view	62	
Fig. 9.—*Lagena marginato-perforata*, Seguenza	140	344
Fig. 8.— ,, ,, ,, Edge view	140	
Figs. 10, 12.—*Lagena bicarinata*, var. *villosa*, nov.	160	357
Fig. 11.— ,, ,, ,, ,, Edge view	160	
Fig. 6.—*Lagena bicarinata*, var. *spinigera*, nov.	100	358
Fig. 7.— ,, ,, ,, ,, Edge view	100	
Fig. 14.—*Lagena danica*, var. *pendulum*, nov.	107	376
Fig. 13.— ,, ,, ,, ,, Edge view	107	
Fig. 15.—*Lagena orbignyana*, var. *baccata*, nov.	107	363
Fig. 16.— ,, ,, ,, ,, Oral edge view	107	
Fig. 17.—*Lagena orbignyana*, var. *yokoyamae*, Millett	135	367
Fig. 18.— ,, ,, ,, ,, ,, Edge view	135	
Fig. 19.—See under Fig. 5.		
Figs. 20, 22, 23.—*Lagena scarabaeus*, sp.n.	90	368
Fig. 21.— ,, ,, ,, Edge view	90	
Fig. 24.—*Lagena formosa*, Schwager	160	350
Fig. 25.— ,, ,, ,, Edge view	160	
Fig. 26.—*Lagena auriculata*, Brady. Variety. Balsam mount	180	379
Fig. 27.— ,, ,, var. *quadri-auriculata*, nov.	115	380
Fig. 29.—*Nodosaria pellita*, sp.n.	125	408
Fig. 28.— ,, ,, Initial chamber denuded of outer coating	125	
Fig. 31.—*Frondicularia scottii*, sp.n. Side view	45	415
Fig. 30.— ,, ,, Edge view	45	
Fig. 32.— ,, ,, Balsam mount	45	
Fig. 33.—*Frondicularia pygmaea*, Sidebottom	135	412
Fig. 34.—*Cristellaria costata* (Fichtel & Moll). Variety.	100	440

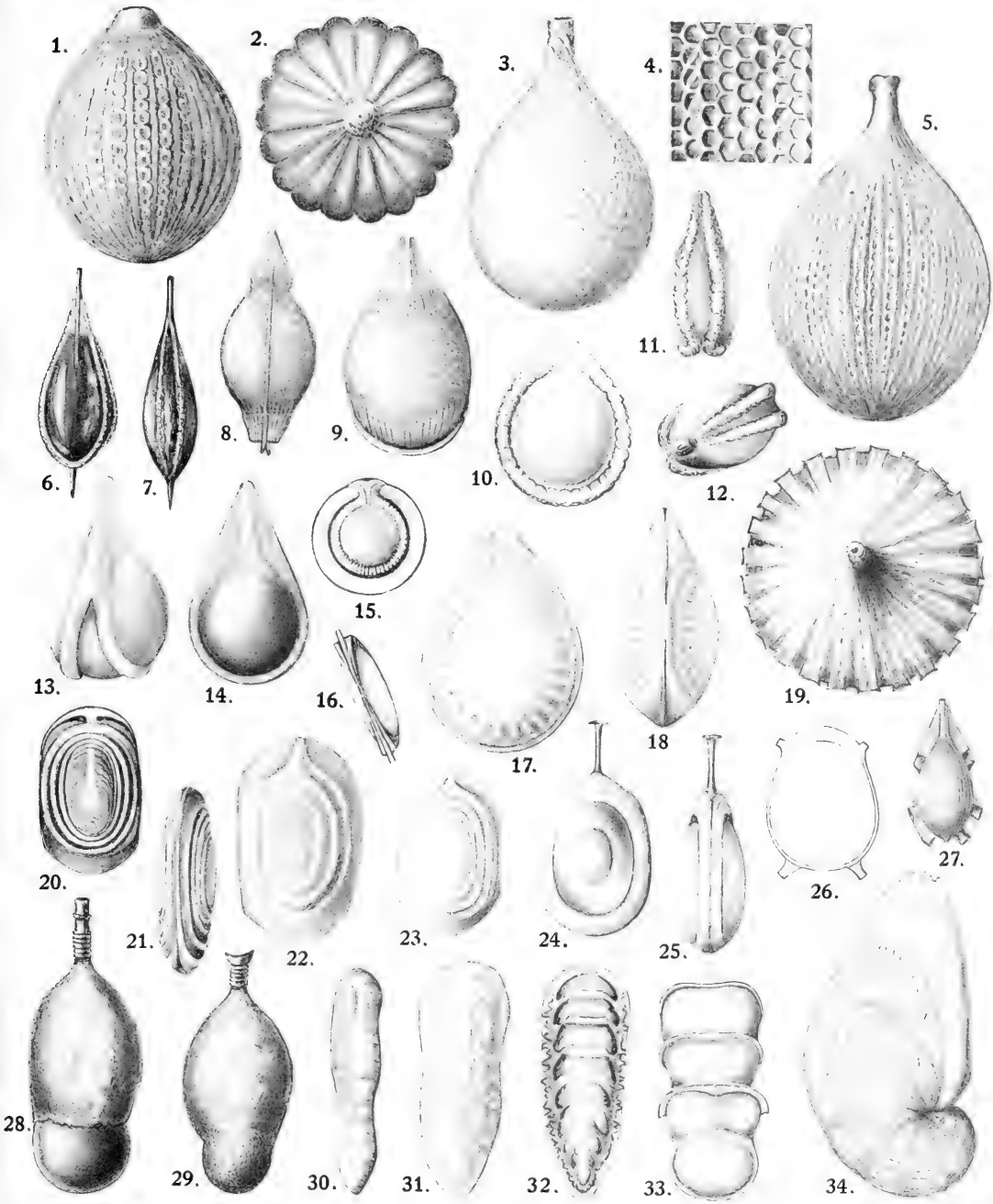
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PLATE VII.

	Magn.	No.
Fig. 1.—*Polymorphina sororia*, Reuss. Aculeate and fistulose variety	70	444
Fig. 2.— ,, *oblonga*, Williamson. Aculeate variety	62	442
Fig. 3.—*Spirillina selseyensis*, Heron-Allen and Earland	160	505
Fig. 4. — ,, *vivipara*, Ehrenberg. Parent shell with young brood	250	493
Fig. 5.—*Patellina corrugata*, Williamson. ,, ,, ,, ,,	125	506
Fig. 6.—*Globigerina cretacea*, var. *eggeri*. Inferior view	90	476
Fig. 7. ,, ,, ,, Edge view.	90	
Fig. 8. ,, ,, ,, ,, Superior view	90	
Fig. 9.—*Discorbina harmeri*, sp.n. Edge view	90	539
Fig. 10.— ,, ,, ,, Inferior view	90	
Fig. 11.— ,, ,, ,, Superior view	90	
Figs. 12, 16.—*Discorbina calcarata*, sp.n. Inferior views	107	538
Fig. 13.— ,, ,, ,, Edge view	107	
Figs. 14, 15.— ,, ,, ,, Superior views	107	
Fig. 17.—*Discorbina wilsoni*, sp.n. Superior view	90	543
Fig. 18.— ,, ,, ,, Inferior view	90	
Fig. 19.— ,, ,, ,, (Superior) edge view	90	
Fig. 20. *Discorbina disparilis* sp.n. Inferior view	90	541
Fig. 21.— ,, ,, ,, Superior view	90	
Fig. 22.— ,, ,, ,, Edge (oral) view	90	
Fig. 23.—*Truncatulina refulgens* (Montfort). Sessile specimens with arenaceous tubular processes	13	549
Fig. 28.— ,, ,, Parent shell with young brood in chambers	62	
Fig. 24.—*Truncatulina terminargo*, var. *alto-camerata*, nov. (Superior) edge view	62	551
Figs. 25, 27.— ,, ,, ,, ,, Superior view	62	
Fig. 26.— ,, ,, ,, ,, ,, Inferior view	62	
Fig. 28.—See under Fig. 23.		
Fig. 29.—*Rotalia soldanii*, var. *arenacea*, nov. Superior view	80	601
Fig. 30.— ,, ,, ,, ,, Inferior view	80	
Fig. 31.— ,, ,, ,, ,, Edge (oral) view	80	
Fig. 32.—*Truncatulina lobatula*, var. *arenacea*, nov. Free, inferior view.	90	551
Fig. 33.— ,, ,, ,, ,, Free, superior view	90	
Fig. 34. ,, ,, ,, ,, Free, edge (oral) view	90	
Fig. 35.— ,, ,, ,, ,, Sessile.	90	
Figs. 36, 38.—*Nonionina turgida*, var. *arenacea*, nov. Side views	110	619
Fig. 37.— ,, ,, ,, Oral view	110	

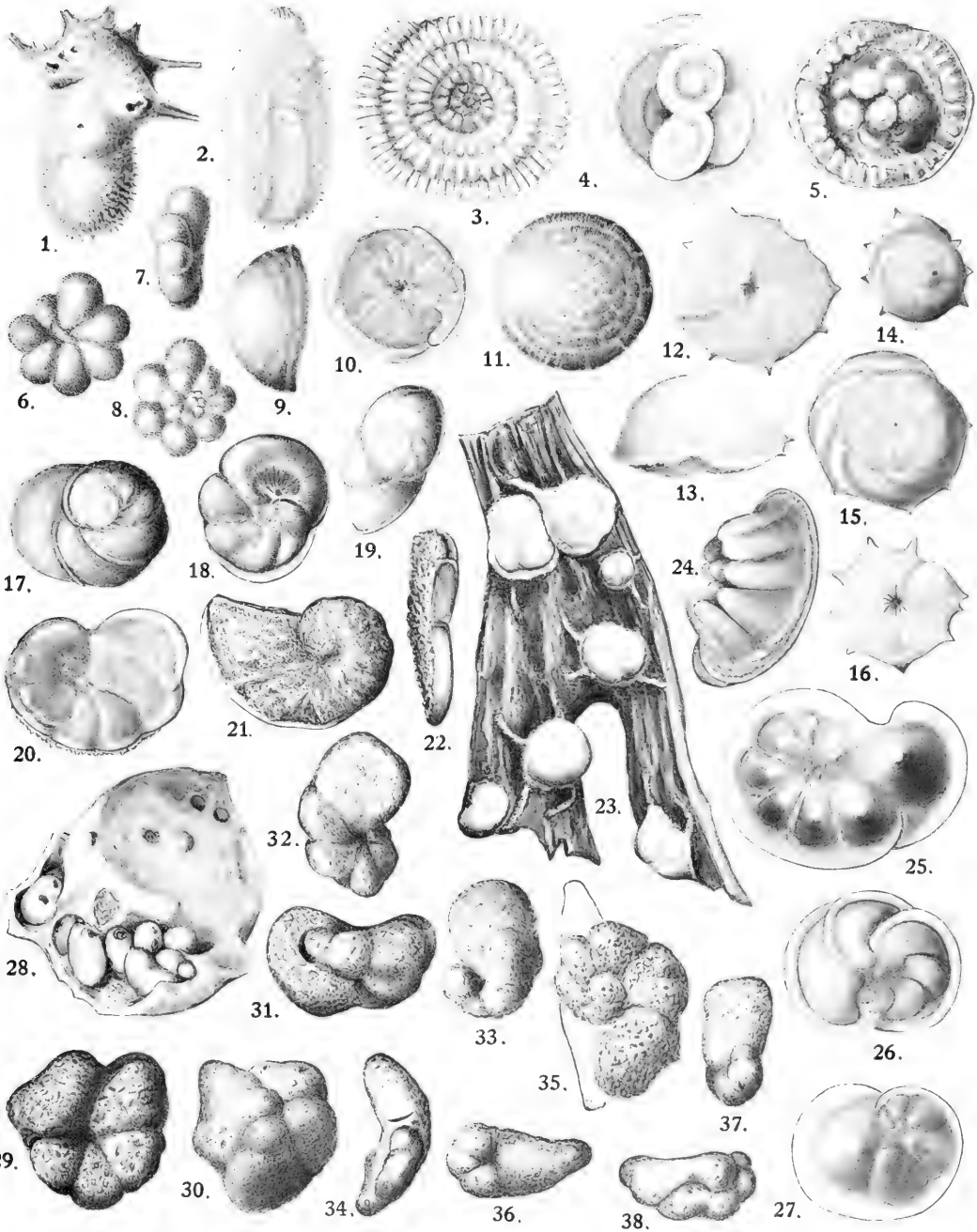
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PLATE VIII.

Polytrema miniaceum (Linné). No. 608.

Note.—Figures 7, 24, and 29 were drawn from Corsican specimens.

Fig. 1.—Earliest observed stage, lying on sponge but apparently not attached.

Figs. 2, 3.—Very early stages of the free form.

Figs. 4, 5, 6, 7.—Development of the free form into the "raspberry" stage. Fig. 7 marks the ultimate possible development, and was not observed in the New Zealand material.

Fig. 8.—The free "raspberry" form becomes sessile. At this early stage the pavement layer of chambers by which it attaches itself is not visible from above.

Fig. 9.—A specimen similar to Fig. 8, detached to show the ruptured pavement layer of chambers.

Fig. 13.—A partial section through a specimen slightly more advanced than Fig. 9, showing the "raspberry" in a nest of pavement chambers which are commencing to form outgrowths.

Fig. 10.—A more advanced specimen which has been attached to the rounded stem of a Zoophyte. The pavement layer and its outgrowths have entirely enveloped the "raspberry," forming two tubular outgrowths, and are spreading round the stem of the host.

Figs. 11, 12, 14.—Stages in the development of the pavement and investing layer of chambers, and the formation of tubular apertures.

Figs. 15, 16, 17.—Further stages of development involving the final disappearance of the "raspberry" in the investing layers.

Figs. 18, 19, 21, 22.—Transition stages up to the adult.

Fig. 20.—Section through primordial chambers of the free "raspberry" stage.

Fig. 23.—An adult specimen attacked by an organism which has tunnelled into the hard test.

Fig. 24.—A similar specimen (from Corsica) in which the ravages of the boring organism have exposed the "raspberry," which, owing to its thicker test, has been left untouched.

Fig. 25.—Adult stage, section showing concentric layers of investing chambers in trunk.

Fig. 26.—Detail of surface-layer from Fig. 25, showing the reticulate character of each investing layer of chambers. The round pits are the first stage in the formation of "pillar pores."

Figs. 27, 28.—Partially decalcified basal portions in which the position and structure of the "raspberry" are clearly shown. The thick chitinous linings of the chambers of the raspberry have resisted the process of decalcification.

Fig. 29.—Basal view of a part of the base of a microspheric specimen, showing rotaline initial chambers.

Fig. 30.—A partially decalcified specimen viewed from the base and showing the chitinous lining of the pavement layer of chambers which had attached the "raspberry" to its host.

Fig. 31.—A fragment of *Polytrema* with envelopment of large sponge-spicules, perhaps due to symbiosis of the two organisms.

Magnifications—Figs. 1, 2, 3, × 50.
,, 4 to 14, 24, × 40.
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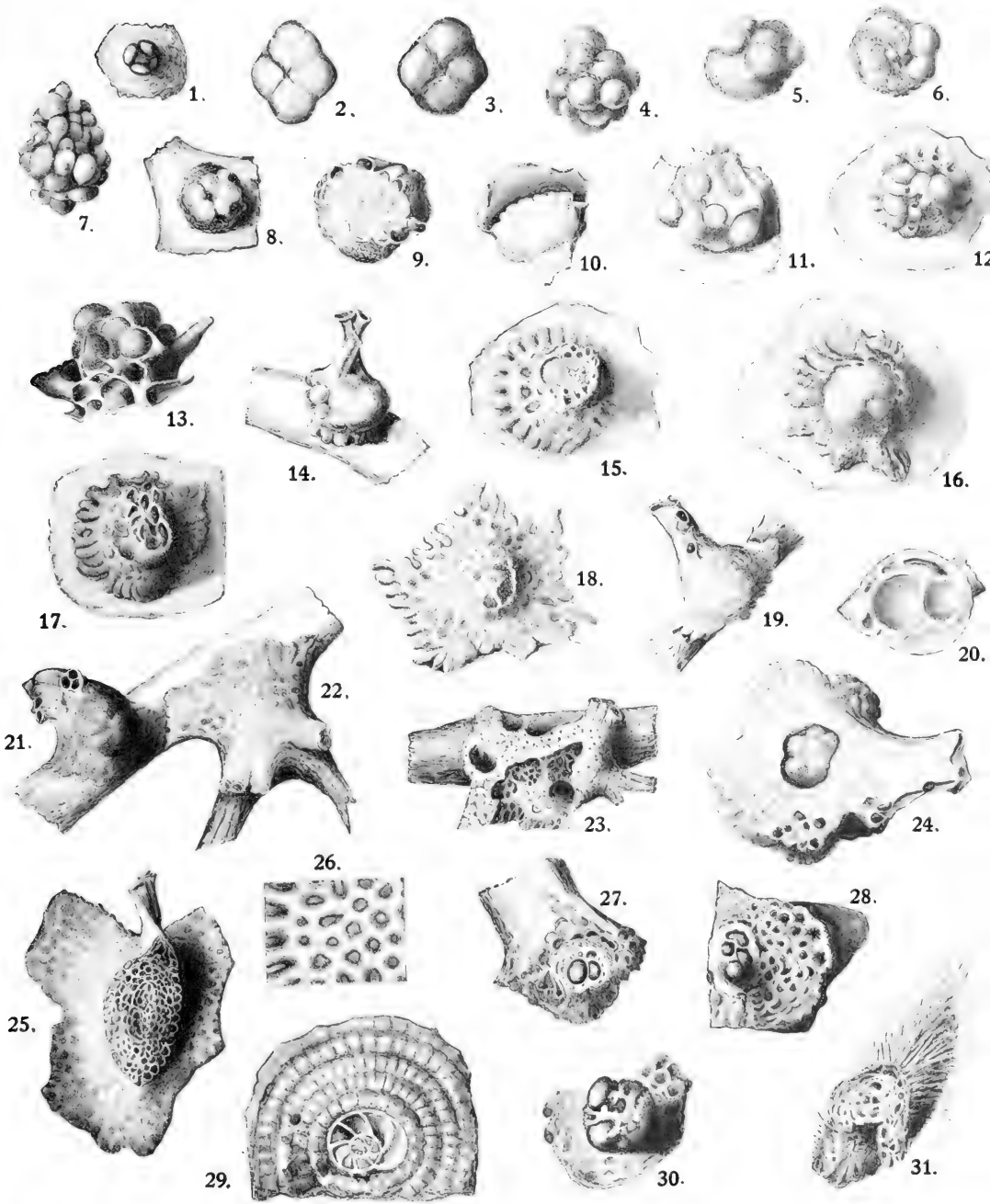
,, 20 and 30, × 60.
,, 21 to 23, 25, × 15.
,, 29. × 90.
,, 31, × 25.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